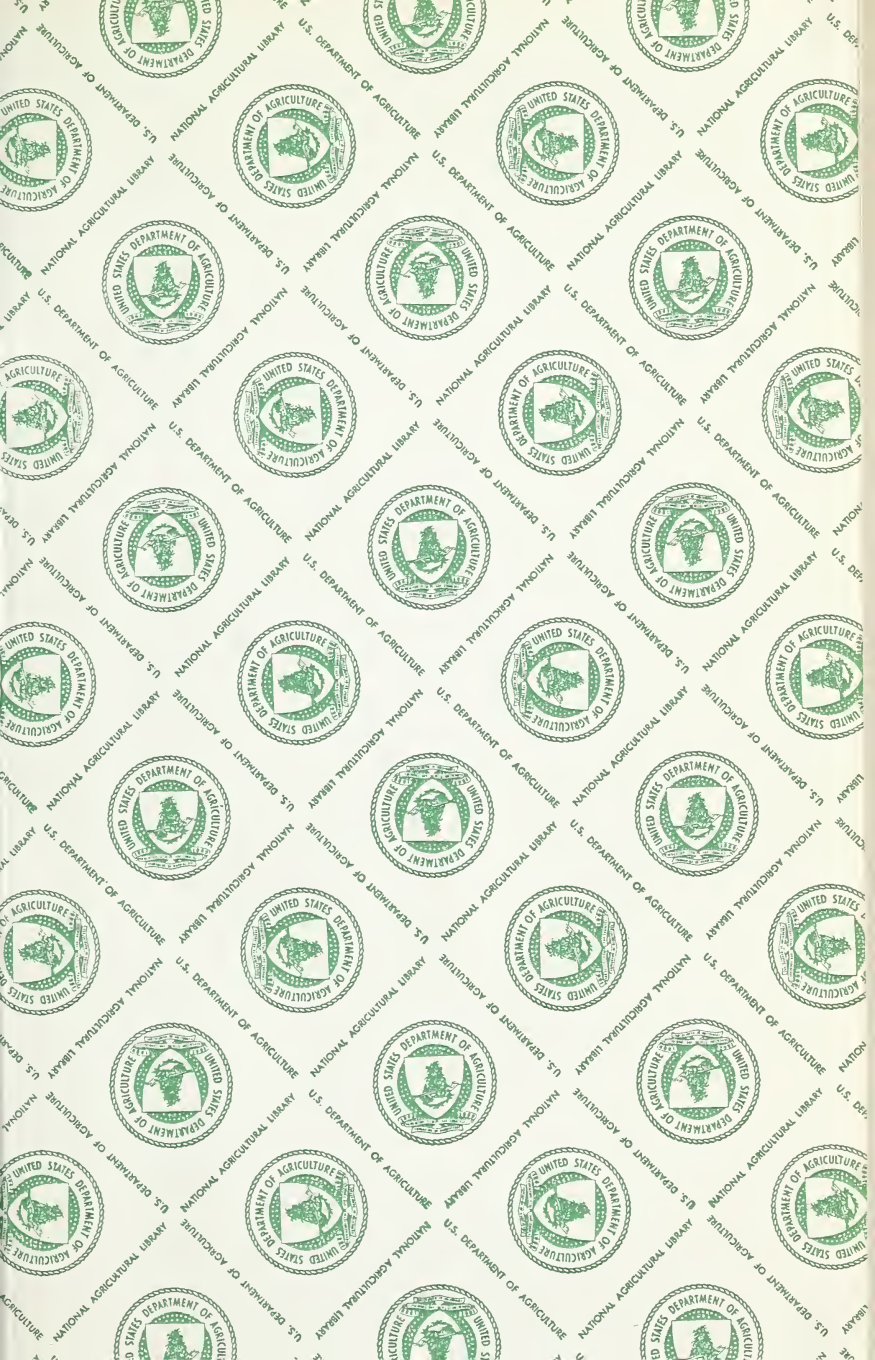


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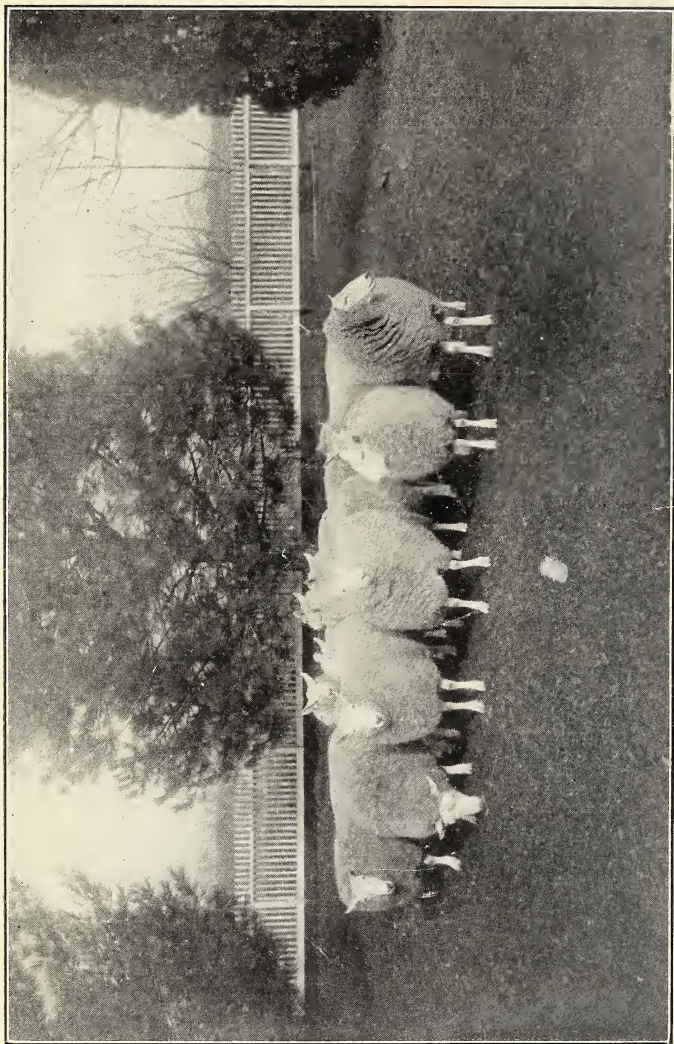
PRACTICAL FARMING



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BEAUTY AND CONTENTMENT.

Cheviot Ewes, owned by S. E. Lentz, Congerville, Ill.

A MANUAL OF PRACTICAL FARMING

BY

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New York

THE MACMILLAN COMPANY

1910

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Set up and electrotyped. Published April, 1910.

Norwood Press
J. S. Cushing Co. — Berwick & Smith Co.
Norwood, Mass., U.S.A.

INTRODUCTION

THE prime purpose in publishing this book is to aid the practical farmer and student of Agriculture. It has been my aim to place before the reader in a plain, practical way useful knowledge and the results of scientific research as applied to the common things in agriculture without the use of technical terms or confusing tables, so that the tiller of the soil may have a friend and handbook to which he may turn with confidence in time of need.

No claims are made for originality or discovery, but if there is merit in the work, it lies in the practical application of scientific facts to the everyday problems and conditions as they are found on the farm.

In the treatment of the various subjects I have tried to present them in the briefest way, and have given the results of scientific research as far as known and as far as they square with practical experience, leaving all theories in the hands of experimenter and investigator. This should enable the reader to secure a fairly accurate knowledge of the subject in which he is interested without the necessity of searching through many bulletins and elementary works. The subjects treated are believed to be those in which the great majority of farmers are most interested.

The science of agriculture (if, strictly speaking, there is such a science) is as broad as the universe, embracing within its domain, to some extent, all other sciences, presenting rich fields in many directions for investigation and discovery, and awaiting the intelligent application of such discoveries to agricultural conditions as we find them.

No man, however great, can know it all, and the wise farmer will profit by the experience of others and apply the knowledge thus gained to the practical business of farming. To the investigator and experimenter in every department of agriculture the farmer owes his debt of gratitude, for they have helped to make farming a dignified, honorable, and successful occupation. They have enriched the world and benefited their fellow-men.

To the farmer I will simply say that I have not attempted to cover the whole field of agriculture, but have confined my work to the things in which I have had some practical experience and which must of necessity be somewhat restricted in the life of any man. It is hoped, however, that many will find this book helpful in their daily work and concede that I have to some degree been able to aid my many farmer friends.

JOHN MCLENNAN.

CONTENTS

PART I

CHAPTER	PAGE
I. THE SOIL	1
II. PREPARING THE SOIL	5
III. TILLING THE SOIL	10
IV. FERTILIZING THE SOIL	14
V. DRAINAGE	20
VI. COMMERCIAL FERTILIZERS	30
VII. APPLICATION OF FERTILIZERS	35
VIII. LIME	46
IX. HOW PLANTS GROW	55
X. THE ROOT SYSTEMS OF FIELD CROPS	59
XI. LEGUMES	65
XII. CLOVERS	78
XIII. OTHER LEGUMES	86
XIV. CORN AND HOW TO GROW IT	96
XV. THE CEREALS	105
XVI. THE GRASSES	120
XVII. ROOT CROPS	124
XVIII. ROOT CROPS FOR STOCK FEEDING	133
XIX. CROP ROTATION	147

PART II

ANIMAL HUSBANDRY

CHAPTER	PAGE
XX. FEEDING FARM ANIMALS	150
XXI. THE DAIRY HERD—ITS FORMATION AND MANAGEMENT	170
XXII. TESTING MILK AND CREAM	176
XXIII. FEEDING FOR MILK AND BUTTER RECORDS . .	185
XXIV. HOW TO FEED CALVES	191
XXV. VARIOUS BREEDS OF CATTLE	194
XXVI. THE ORIGIN OF THE HORSE AND THE DEVELOPMENT OF VARIOUS BREEDS	211
XXVII. DIFFERENT BREEDS OF HORSES	213
XXVIII. GENERAL DISCUSSION OF THE HORSE . . .	230
XXIX. MANAGEMENT AND FEEDING OF SHEEP . . .	235
XXX. PIG MANAGEMENT AND FEEDING	243
XXXI. POULTRY ON THE FARM	257
XXXII. THE FARM ORCHARD	261
XXXIII. SOME PRACTICAL SUGGESTIONS	278

LIST OF ILLUSTRATIONS

Beauty and Contentment	<i>Frontispiece</i>
	PAGE
A Good Combination Plow	6
Sulky Plow	8
Root System of Alfalfa	22
Tile-laying System	24
Right and Wrong Ways of laying Tile	25
A Successful Ditch Digger	<i>facing</i> 26
Timothy, limed and unlimed	49
Alfalfa, limed and unlimed	51
Watermelons, limed and unlimed	52
Root System of Corn	60
Root System of Potato	63
Alfalfa Plant	67
Alfalfa in Well-drained Soil	68
Alfalfa in Poorly drained Soil	69
Young Alfalfa Plants	<i>facing</i> 72
Alfalfa Plant, High Water Table	74
A Good Mulch Maker	102
A Good Style of Cultivator	129
Experiment in Potato Spraying	<i>facing</i> 130
Mangel Wurzel Beets	" 136
Lavender Clipper	" 151
Howie's Dairy King	" 154
Gladiator	" 168
Missy of the Glen	" 172
Spring Balance Scale	178
Upland Laura	<i>facing</i> 180

	PAGE
Colantha 4ths Johanna	<i>facing</i> 186
King Segis	" 194
Dolly Dimple	" 196
Imp. King of the May	" 198
Imp. Croft Jane Dinah 19th	" 200
Upland Hobby	" 202
Hereford Bull, Sailor	" 205
Golden Bud	" 206
Glenfoil Thickset	" 208
Meanwood Majesty	" 214
Peter the Great (2.07 $\frac{1}{4}$)	" 216
Winchester	" 218
German Coach Stallion	" 220
General Gates	" 222
Sapinette	" 224
Tom Darnley	" 228
Percheron Stallion	" 232
Champion Shropshire Ram	" 236
Merino Ram	" 240
Floor Plan for Hog House	245
False Floor in Hog House	246
Windows in Hog House	246
Portable Hog House	247
Hog House, Front Closed	248
Hog House, Front Open	249
Hampshire Hogs	<i>facing</i> 250
Fender in Hog House	253
Raised Partition in Hog House	254
Convenient Hog House	255
Grand Champion Berkshires	<i>facing</i> 256
Imp. Large Yorkshires	" 256
Spraying Peach Trees	" 274

PRACTICAL FARMING

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CHAPTER I

THE SOIL

THE first and fundamental subject to be treated in a work of this character, and the foundation on which must rest every development in agriculture, is the soil.

The soil, as the term is commonly understood, is the top surface of the earth extending only a few inches in depth, and is the part usually occupied by the roots of growing plants.

The subsoil is that portion of the earth lying immediately below the soil, is not cultivated, and is comparatively little used by plant roots.

SOIL COMPOSITION

Both the soil and the subsoil are primarily composed of molecules; that is, minute grains of rock of varying sizes and forms. These are simply a result of the action of the elements, such as frost, rain, wind, and heat in breaking down and disintegrating the surface rock. Mixed with the soil particles will be found also more or less decaying organic matter known as humus.

SOIL AIR

These soil particles or molecules do not form a solid mass, but a more or less open and porous substance with air spaces between the particles through which the soil air should circulate freely. As an illustration, we might compare it to a glass filled with very small shot.

SOIL WATER

Besides the air which circulates among the soil particles, each separate particle is surrounded with a film of water, held in place by the force of adhesion. This water is known as soil moisture.

HUMUS

In addition to the air and water which permeate the soil, there is also mixed with it, in varying quantities, organic matter such as decaying roots of plants, leaves, manure, and other decomposing vegetable matter. This organic matter is known as humus.

In localities which are not readily drained the vegetable matter, or humus, may accumulate so as to comprise substantially the whole surface of the soil. Such localities are then termed swamp or muck land.

The humus or decaying vegetable matter in the soil aids in the production of nitrogen, which is one of the most important as well as the most valuable of plant foods.

MINERAL ELEMENTS OF THE SOIL

Besides the nitrogen produced by the decaying humus, the soil also contains potassium, calcium, magnesium, phosphorus, sulphur, iron, and chlorine, and if a soil is

deficient in any of these essential elements of plant food, it will not produce a satisfactory crop. With the open particles among which the air can circulate freely, the water or soil moisture which surrounds each particle, and the several varieties of plant food mentioned above, we have an ideal soil.

UNFAVORABLE SOIL CONDITIONS

If there is an excess of moisture in the soil, the air will be driven out and the necessary oxygen will be denied the plant roots. If, on the other hand, there is a deficiency of water, as in case of severe drought, the plant food will remain undissolved in the soil and the plant roots will starve, being unable to absorb the plant food except in solution.

GOOD SOIL CONDITIONS

Generally speaking, then, good soil must be sufficiently dry to permit a free circulation of air, moist enough to hold in solution the various forms of plant foods, and rich in the various ingredients which are necessary to plant life, especially nitrogen, phosphoric acid, and potash.

CHARACTER OF VARIOUS SOILS

The soil may be composed of rather coarse particles, such as sand or sandy loam, with usually a gravel subsoil, or of finer particles known as clay loam, with a rock or clay subsoil (sometimes known as hardpan); or it may be of a muck character, with frequently a subsoil of marl.

The sandy loam or sandy soil is quick to respond to applications of plant food, and is capable of storing and absorbing large quantities of moisture, but it is more

readily affected by drought than the finer soils, and plant foods are more liable to be washed out and lost. The clay soils absorb moisture much more slowly and retain it longer; they also retain for a much longer period applications of plant food, for which reason they are usually called strong soils.

The clay subsoils, however, being more impervious to penetration by the roots of deep-growing plants, are less desirable for the cultivation of that class of plants.

The muck soils are usually unsuitable for any purpose, because of the excess of water and consequent exclusion of air, until they are properly drained, when they frequently become the most fertile and profitable of soils.

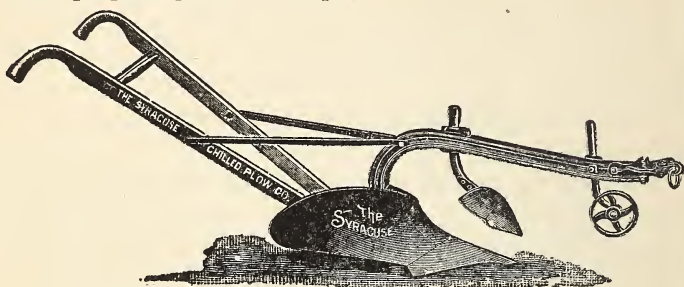
CHAPTER II

PREPARING THE SOIL

It is apparent that the finer the soil particles and the more thoroughly the soil can be broken up and pulverized, the better will be the circulation of air through it and the more water it will hold. To illustrate: if a tumbler is filled with very coarse shot, and water is poured into it and afterward removed, each shot will be found surrounded with a very thin film of the fluid, and the total moisture so retained will represent a considerable percentage of the whole quantity first poured into the glass. Now, if the glass is filled with very fine shot and exactly the same quantity of water is poured into it as was used with the coarse shot, and then removed, the shot in the second glass will retain probably twice as much water as did the coarse shot in the first glass.

It is an established fact that all plant food, in order to become available for the use of plants, must be held in solution. The simple experiment noted above proves that the finer the soil particles, the more water they will retain, and consequently the more plant food will be held in solution and rendered available. It is also true that soil composed of very fine particles facilitates the thorough mixing of the humus and other plant foods with these

particles, and tends to bring the plant food in closer contact with the plant roots. Therefore it is necessary to break down and pulverize all clods and hard pieces of soil when preparing it for a crop.



A good combination plow.

PROPER PLOWING

The first step in preparing soil for any crop is proper plowing, and the time and manner of performing this work must be determined by the climate of a particular locality and the character of the soil. Much also depends upon the kind of crop which is to follow. Generally speaking, the clay soils may be plowed to good advantage in the late summer or autumn, because the frosts of winter tend to break down any clods which may have formed, and of added importance is the fact that fall plowing makes it possible to begin much earlier in the spring with seeding for the coming crop.

Spring plowing may be advantageously practiced on soils of a sandy character and which are naturally well drained. Such soils do not readily form clods, and more quickly become dry and in proper condition for tillage.

THE TIME TO PLOW

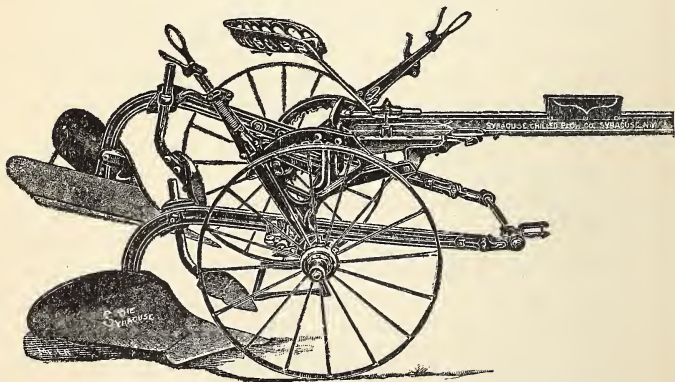
The proper time to plow should be determined not so much by the time of year or the season as by the condition of the soil. Cultivation should not begin on any soil that is either too wet or too dry. If too wet, the action of the plow and the tramping of the horses' feet will compact the soil into hard, unyielding clods; these, if allowed to dry, will exclude all air and water and remain wholly useless in providing plant food. Plant roots cannot penetrate such clods of earth, and they become a direct menace to the coming crop in proportion to their number and size. If for any reason such clods do exist, they must be thoroughly broken down before the crop is planted. The result of plowing clay soils when too wet is known as "puddling," and it is usually disastrous to that soil for several years. Almost any clay will produce brick if sufficiently worked when wet. The same condition exists in the soil if it is plowed when too wet.

The sandy soils may be plowed when containing more moisture than clay soils, but even these should present a firm, elastic condition when ready for the plow. On the other hand, no soil should be plowed when too dry. Such plowing simply breaks off and turns up large, irregular-shaped chunks of earth which are in no condition to cultivate. Such plowing also requires a large amount of additional power, also much additional labor in breaking up the clods, with no possible compensating results. The proper time to plow the soil is when the plow leaves the inverted furrow in a mellow, elastic, and crumbling condition. There should be moisture sufficient to make

the plow clean well, but the moldboard should not leave a "shiny" surface on the soil. If the soil crumbles readily in the hand, it is, generally speaking, in good condition for plowing.

THE DEPTH TO PLOW

The proper depth to plow must be governed by the nature and condition of the soil. Usually sandy loam may be plowed deeper than clay loams, because hardpan, or clay, commonly underlies the latter, and it is undesirable to bring to the surface large quantities of such clay. As a rule the wisest plan is to plow a little deeper each successive year, so that the deeper soil may become gradually mixed with the humus, until a depth of nine or ten inches is reached. If the soil is naturally damp and poorly drained, it will be benefited by plowing it in narrow "lands" and making good open dead furrows so laid off as to conduct any surface water from the field.



Plowing is a pleasant occupation with this machine.

If the soil is liable to become too dry in summer, or is a side hill which is inclined to wash during spring freshets or heavy rains, dead furrows should not be plowed, and all furrows should lie across the face of the sloping land. This method will tend to prevent washing, and also will aid in retaining the moisture in the soil.

The question of subsoiling is still in the experimental stage, and it is not settled whether it is good practice to use the subsoil plow.

CHAPTER III

TILLING THE SOIL

AFTER the soil is properly plowed, and just as soon as the surface begins to look slightly dry, the field should be thoroughly harrowed. It is not good practice to delay the harrowing until the whole field is plowed; the harrow should follow the plowing before the clods have become dry. If the soil is harrowed soon after being plowed, such clods will be readily broken and pulverized, but if allowed to become thoroughly dry, it will be found quite impossible to completely pulverize the soil by any ordinary means. Much additional labor is then required to get the field in approximately good condition.

As a rule, in good weather, a harrow should follow not more than one day behind the plow.

The harrowing should be just as deep as it is possible to set a good spring-tooth harrow, and so thorough that every clod, whether on the surface or beneath the surface, will be thoroughly pulverized. If clods of considerable size and number remain after the harrow, then roll the land, breaking down the clods in that way, and harrow again.

Many soils which, in former years, were plowed when too wet and were badly puddled will continue to furnish clods for years after unless they are broken down, as here suggested.

THE TIME TO HARROW

As different soils under different conditions and at different seasons of the year will require longer or shorter periods of time between the plowing and the harrowing in order to be in proper condition to secure the best results, it is important that there should be some test which may be applied to each individual field to determine the proper time to harrow. Such a test may be made by taking a lump of earth in the hand, and if it crumbles at the slightest touch and does not form a paste between the thumb and fingers, it is time to start the harrow.

CONSERVING SOIL MOISTURE

Besides the benefits just enumerated resulting from starting the harrow at the proper time, another and quite as important a consideration is that of conserving the moisture in the soil. As will be noted in a subsequent chapter, one of the chief factors in successful tillage is the conservation of soil moisture, and the very first step taken in that direction is starting the harrow at the proper time.

As is well known, both the soil and subsoil store up vast quantities of water, the result of months of accumulation from winter snows or spring and winter rains. This moisture must be conserved for the use of plant life during the growing season of the year. The loss of moisture from the soil in the summer season and in periods of drought is largely the result of the capillary movement of water through what is commonly known as capillary attraction. This is simply the tendency of the

particles of water to lift themselves upward, to travel through the soil between the soil particles until the surface is reached, when the moisture is quickly evaporated and passes off in the air.

As an illustration of capillary attraction in all fluids, place one end of a coarse towel in a pail half filled with water and the other end on the floor. The water will soon be found on the floor, having traveled upward and over the rim of the pail, following the threads or particles of the cloth. In just the same way the moisture is taken from the soil by capillary attraction, unless prevented as far as possible by starting the harrow at the proper time and subsequent frequent cultivation.

If the soil is left for a long time undisturbed during the spring or summer season, it will become a continuous compact mass from the surface down to the subsoil, thus forming the best possible conditions for the capillary movement of water. If this condition is allowed to continue, the soil moisture will soon be exhausted, and the surface will bake and crack open under the summer heat.

SOIL MULCH

Referring again to our illustration of the pail of water and the towel, it is evident that if the towel were cut off below the top of the pail and inside of the pail, there would be no loss of water. Similarly, it has been found by experience that if a mellow condition, or, as it is commonly called, "mulch," is maintained on the surface of the soil, the capillary movement of the moisture will be largely retarded and the water conserved for the use of the coming crop. To illustrate this fact, if a plank lies

long on the ground, even in a time of severest drought, and is turned over, the soil under it will be found moist and soft, while the earth all about it is hard and dry.

The mellow surface mulch also serves another and almost equally important purpose. It allows the air to enter freely into the soil, which would not be possible if the surface was allowed to remain in a hard, compact mass. Air circulation among the soil particles is just as essential as soil moisture. Proper tillage of the soil prevents the moisture from escaping and aids the air in entering.

ANIMAL LIFE IN THE SOIL

Countless numbers of microscopic forms of life, such as bacteria, germs, worms, and insects, exist in the soil and are a necessary element in the plan of nature. Some of these are constantly at work breaking down the rock particles and converting them into soil ready for plant food. Others construct their homes in the roots of plants, and by some wonderful unknown power extract the nitrogen from the air and convert it into nitrates which are supplied to the plants. Other forms still, act in converting the decaying vegetable matter found in the soil into nitrates and other forms of plant food. All of these animal forms must have air; hence the necessity of proper soil aëration.

CHAPTER IV

FERTILIZING THE SOIL

FERTILITY is, of course, one of the essential conditions of the soil for successful farm husbandry. In fact, fertility and proper tillage are the twin pillars upon which must rest every structure and every plan of agricultural activity. Fertility without proper tillage results in weeds and disappointment. Tillage without fertility results in wasted energy and financial loss.

In a preceding chapter we have seen that, in order to support plant life, certain forms of plant food must be contained in the soil. Some of these are provided by natural causes and are always found in the soil in more or less abundance; but some of them, and generally the more important, must be supplied artificially by the husbandman in all soils which have been many years under cultivation.

NITROGEN

One of the most important forms of plant food is nitrogen, and it may be found in the soil in several distinct forms. The most important form, and the substance which carries the largest proportion of nitrogen, is humus. It also is found in the form of free nitrogen, which is appropriated in some manner by microscopic forms of life that live in the roots of plants, converted into some

form of nitrates and supplied to the growing plant. It also exists as nitrates of lime, magnesia, potash, ammonia, and nitric acid. In whatever form it occurs, it is always one of the most essential as well as the most expensive of plant foods, and without it no crop can develop to maturity. How, then, can nitrogen be supplied to the soil?

BARNYARD MANURE

First of all comes barnyard manure. In order to secure the best results with this, it must be handled properly and applied intelligently. Barnyard manure includes not only all of the solids voided by farm animals, but all the liquids as well. In fact, the liquids comprise about 70 per cent of the plant food available in barnyard manure.

Where barnyard manure is used to fertilize the soil in preparation for a crop to be grown on plowed land, the manure should be thoroughly mixed with the soil particles in order that the humus may come into close contact with the fine, growing roots of the plants. If the manure is well rotted, this may best be done by spreading it upon the soil after harrowing the first time, and then complete the application by thorough subsequent harrowing. If the manure is not rotted, and contains considerable quantities of straw or other roughage, it will be found more profitable and advantageous to first spread it upon the land and then plow it under. The rotted manure applied upon the surface will give quicker results, but the coarse manure plowed under will be more lasting in its effect upon the soil. The well-rotted manure has

necessarily suffered considerable loss in the process of fermentation, and a considerable percentage of ammonia and nitrogen has probably escaped into the air. There is also usually some loss of liquid.

As a general rule it is better practice to apply manure direct from the stable every day, both solid and liquid, except such as may be required for top-dressing of meadows or truck gardening. Another exception should perhaps be made in the case of very coarse sandy soil having a loose, gravelly subsoil. In the latter case it is believed that much of the nitrogen is liable to wash out before the plant roots can appropriate it if plowed under.

One of the most serious problems confronting the tiller of the soil to-day is that of how to keep up the fertility of the soil in the absence of barnyard manure, for it is a well-known fact that there is not nearly enough made to fertilize the land now under cultivation. Some other means must, therefore, be found to supply the deficiency.

GREEN MANURES

Many successful experiments have been made in growing and plowing under green crops, and in that way supplying the necessary humus and nitrogen. Very satisfactory results have been obtained by sowing some of the leguminous crops, such as crimson clover, red clover, alfalfa, or cowpeas. Some experts, however, favor the use of non-legumes, such as rye, buckwheat, or even sowed corn.

If the practice of plowing under green crops is to be undertaken, it is believed to be the wiser course to use the leguminous crops because of the wonderful power of

those plants, aided by soil germs, to extract nitrogen from the air and return it, at least to some extent, to the soil. Such plants also help very materially to aerate the soil and render it porous, making it more accessible for both air and moisture. It has, however, been the experience of some that the practice of plowing under green crops produces an acid condition of the soil, by reason of the fermentation which takes place while the green crop is decaying. This, while probably true to some extent, would not be likely to injure the succeeding crop unless it belonged to the family of legumes. Even then, such acidity could be corrected by the application of lime, and even without the application of lime the non-leguminous crops would probably not be injuriously affected. In fact, there are many crops which seem to thrive quite as well with some acid in the soil.

Altogether it seems to be a wise practice to plow under green crops to keep up the fertility of the soil when there is a failure in the supply of barnyard manure. It has also become the general practice to supplement the barnyard manure with commercial fertilizers containing various kinds of plant food in more or less concrete form; and this practice, while it is believed by many to be necessary and desirable, is still open to some very serious objections, among which is the fact that such fertilizers are very expensive, and are exceedingly difficult to retain in some soils long enough to allow the roots of the plants to use them.

Another serious objection to commercial fertilizers is the fact that they add no humus to the soil, neither do they in any degree lighten it or render it more porous.

A third objection is that there is very little if any result after the first year from their use unless applied in large quantities. While it may be necessary to use such fertilizers to some extent as a temporary expedient, it is confidently believed that no general permanent improvement of the soil can result from such use except in so far as they aid in producing green crops which may be plowed under and thus indirectly aid in permanent improvement.

OTHER SOURCES OF FERTILIZERS

Another source from which it is believed a vast quantity of very desirable fertilizers could be obtained is to utilize the waste from our large cities. The street sweepings, the sewage, the stable manure, the refuse of markets, the waste from millions of people and hundreds of thousands of animals should be used to enrich the farmer's land, instead of going to waste in harbors, rivers, and creeks. It would seem to be practicable, at least for the farmer living along the line of our canals, rivers, and railroads, to secure a portion of this tremendous amount of wealth that is now lost.

SAVING FARM FERTILIZERS

One of the most important lessons to be learned by the tiller of the soil is the best method of conserving his own fertilizers and their proper application to his land. In the present condition of our soils every crop grown is dependent directly upon fertilizers, which must be supplied in some form. Nothing yet discovered equals barnyard manure. Yet it is believed that at least one half

of this valuable material is allowed to go to waste by the man most deeply interested.

About 70 per cent of the plant food found in good manure is contained in the liquid portion; most of this is allowed to go to waste. The remainder is usually piled in large heaps, where it ferments in the open, liberating large quantities of ammonia and free nitrogen which escape in the air. This represents a total waste of very large proportions.

CHAPTER V

DRAINAGE

DRAINAGE, as it applies to agriculture, has two fundamental purposes: first, to increase the yield of crops; second, increased healthfulness.

Drainage may be either natural or artificial, and may exist in any degree, from perfectly drained land to that which is very poorly drained. Natural drainage results where nature has provided brooks, creeks, and other outlets through which surface water is readily removed, and where the surrounding soil is open and porous and so situated that the surplus water contained in the soil finds easy access to such outlets.

Artificial drainage is such treatment of the soil as will remove the surplus water where nature has failed to do it, and includes such methods as open ditches, covered stone trenches, plank sluiceways and underground tile. After many years' experience, the latter method has been found most satisfactory for farm purposes, and has been generally adopted.

There are three general classifications of soil which practical experience has demonstrated are very materially benefited by drainage, viz.: First, the pronounced marsh lands which have practically no crop value until drained. Second, the heavy clay soils which, by reason of the fine particles composing the soil and its impervious charac-

ter, are rendered very retentive of water and slow to discharge any surplus accumulation. Indeed, evaporation is the principal means by which this class of soil is relieved of its surplus moisture. Third, in which class are included all of the upland soils of rolling topography, comprising a much larger area than the two other classes combined.

BENEFICIAL EFFECTS OF DRAINAGE

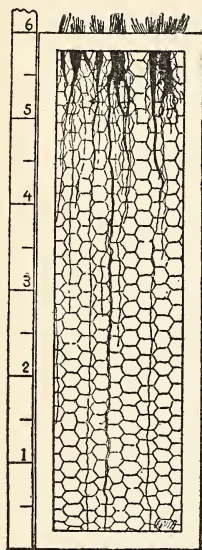
Drainage removes the surplus water from the soil and renders it more firm for tillage operations. Drainage changes the physical condition of the soil from a compact, impervious character to one of open, granulated condition favorable to the free circulation of air, with increased capacity to store soil moisture, and greatly increases the root area of plants.

Drainage renders the soil several degrees warmer than undrained land, and hence materially lengthens the growing season. Drained land can be tilled much earlier in the spring and much sooner after hard rains in the summer than undrained land. Because of this higher temperature of the soil, crops will grow and mature later in the fall.

Drainage increases the available food supply in the soil and enables the plant to make better use of the soil moisture, because of the increased moisture-retaining capacity, the higher temperature, the increased aëration and the increased root area, all of which tend to increase the growth of soil bacteria and act directly upon the minerals of the soil as oxydizing agencies.

Drainage tends to lower the average water table, and

hence reduces the level of stagnant water into which plant roots cannot enter, with the result that the plant roots penetrate the soil deeply instead of spreading out laterally.



Root system of alfalfa growing in a well-drained soil. As the water table is lowered the root area and plant foods are increased.

Another result consequent upon drainage and a lowered water table is the prevention of injury to crop roots by "heaving," or the freezing of large quantities of water in the soil. The effects of heaving are very noticeable on all winter crops of shallow-rooted plants, and it is almost certain disaster to the deep-rooted plants such as the clovers, alfalfa, or any of the other legumes through breaking and destruction of the roots.

Drainage reduces the injury usually resulting from erosion — the washing away of the soil as the surplus water flows over it. Injury from erosion is usually more marked in its effects on clay soils, because such soils permit the surface water to penetrate them very slowly. Hence the desirability of draining clay soils of rolling topography.

Besides increasing the crop yield, lengthening the growing season, reducing injury from frost, and securing the several other advantages enumerated above, we have still another result from drainage quite as important not only to the tiller of the soil, but to the community in

which he dwells, to wit, increased healthfulness. Well-drained land produces no malaria, mosquitoes, or fevers.

There is still another benefit resulting from proper drainage that has recently been advanced by prominent writers on the subject. This is the removal of soluble salts which collect in stagnant soil water and become poisonous to plants, causing what is known as acidity in the soil. It is also believed that growing plants exude or throw off certain poisonous products known as "toxin," which, being left in the soil, render it unfit for subsequent crops until removed by proper drainage.

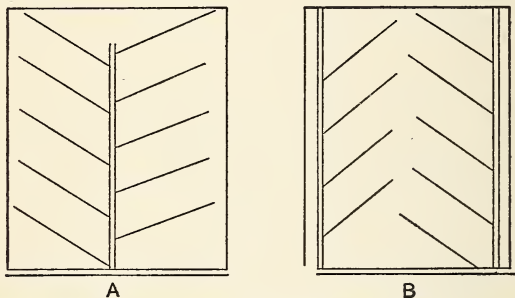
DRAINAGE SYSTEMS

There is no fixed rule for the construction of a drainage system. So much depends upon the conditions involved in each proposition that each one must be solved with reference to the surroundings. Soils are so variable in texture, and soils of similar texture differ so materially in structure, compactness, depth, and the presence or absence of aluminum, silicates, and other deposits that a proper system for one locality would not be the right one for another locality. Experience and good judgment, applied under a few general rules, will, it is believed, generally give satisfactory results.

There are two common types of drainage systems. First, the irregular system which follows the natural depressions in the surface of the land. This system generally results in removing the water from the low places only. This is the system adopted in a large part of the country, and in comparison with its cost brings a splendid return in crops, the land drained nearly always

proving to be the most fertile and profitable part of the farm.

Second. The second system is so arranged that the lines of tile are at uniform distances apart over the entire extent of the field to be drained; it is sometimes called the gridiron system. This system should be adopted wherever the field is rather uniform in topography and the soil of such character that the whole surface is slow in drying, is backward and cold. It is illustrated in the following figures, A and B.



REFERENCES: Sandy loam. Center line of Figure A and side lines of Figure B, 4-inch tile. All the remainder, 3-inch.

In laying out a drainage system where the land is low and nearly level and the fall of the outlet is small, the danger to the inexperienced will be that he will try to make the water run uphill. To avoid mistakes of this nature, it will be wise to employ a competent engineer to lay out the plan showing a grade system with stakes to indicate the necessary cuts. An improper grade of only a few feet in extent in any part of the work may render the whole system useless above that point; but a properly

constructed system is a permanent improvement and will render satisfactory service for several generations.

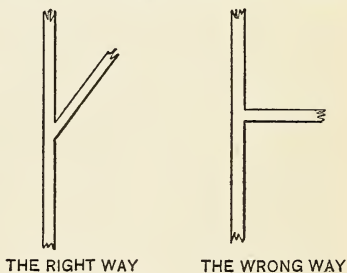
In the majority of cases, however, the grade will be so apparent that an engineer's services will be unnecessary. In every case the course of the mains and laterals should be staked out before excavation is begun, the aim being to secure an even, constant grade throughout the entire system.

Begin excavation at the outlet of the system and follow the main line to the end. Wherever a lateral joins the main line, or where two laterals are joined, the junction should be made at an acute angle; never at a right angle. (See illustration of the two angles.) The water flowing into the main at an acute angle will tend to clear away any sediment which may have been deposited in that vicinity. If it empties into the main tile at a right angle the tendency will be to impede the flow and cause the precipitation of sediment.

Secure the greatest fall possible, because the greater the fall, the greater the capacity of the system.

In many places it will be impossible to secure much fall, but when properly laid, tile will work well with a fall of only one inch in 100 feet.

It is important that the outlet itself shall have a good fall and clear discharge and be always well protected; also that the main should have no less fall than the laterals.



DEPTH OF TILE

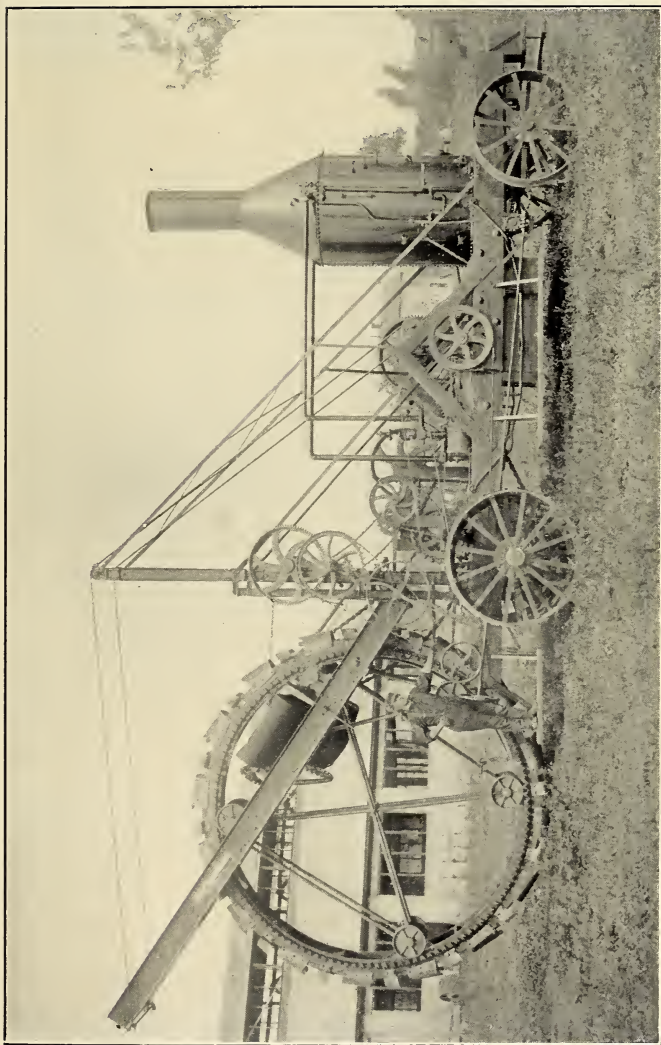
The depth at which the tile is to be placed will be governed by the character of the soil and the danger from frosts. Sandy loams and very porous soils will generally require the tile to be laid at a depth of $3\frac{1}{2}$ to 4 feet, but in clay loams $2\frac{1}{2}$ feet will usually be found satisfactory, unless it should be thought advisable to lay them deeper to escape all danger from frost.

DIGGING THE DITCH

Where convenient, it is practicable to use a plow in the first operation of opening the ditch. If the ditch is to be cut through sod land, or, as often happens, through tough bog grass, a plow with sharpened coulter will save much hard work. After the sods and loose earth are thrown to one side, the ditching plow can be used to good advantage. Any instrument that can be used with horse power and save hand labor should, of course, be utilized. The bottom of the ditch, however, must be completed by hand, and should be done by an experienced, careful man. The perfect grade of the bottom of the ditch will insure the success of the system. For this work there are several special tools in the market, including spades, finishing hoes, tile hooks, etc.

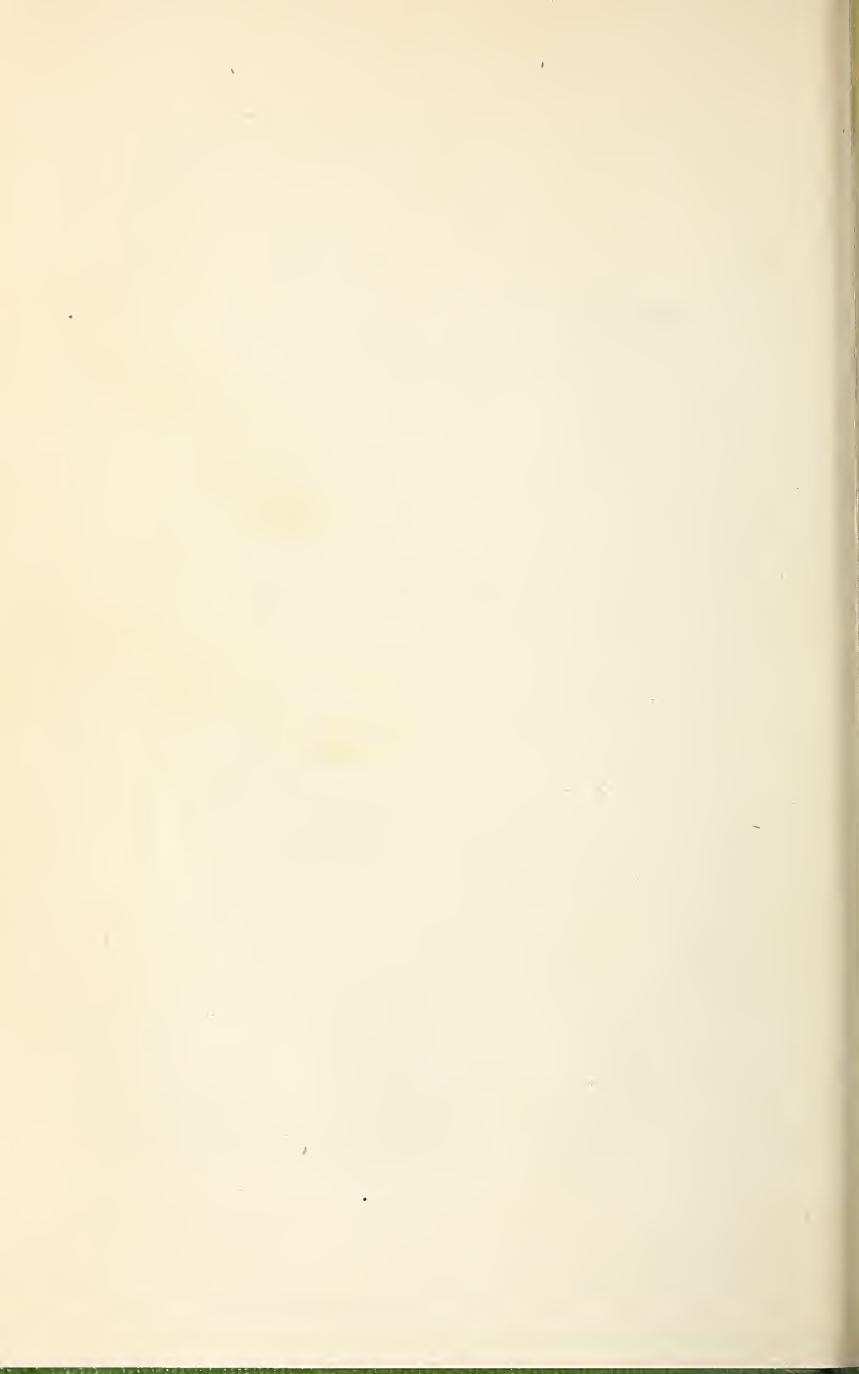
DITCHING MACHINES

If the system proposed is a very large one, or if several farms in the same locality are to be drained, it might be profitable to secure a ditching machine to do the work. Under fairly good conditions the cost of digging a ditch may be materially lessened by using such a machine,



A SUCCESSFUL DITCH DIGGER.

By courtesy of the Buckeye Traction Ditcher Co., Findley, Ohio.



provided the total amount of work to be done would warrant it. It is claimed for these machines that no hand work is necessary in preparing the ditch to receive the tile, and that ten rods per hour can be completed at a depth of three feet.

LAYING THE TILE

The tile should be carefully laid and the ends fitted so that no earth can enter the drain. It is not necessary to protect the joints unless the ditch extends through muck or quicksand. In that case a handful of hay, straw, or sod covering the joints will protect them and prevent the inflow of sediment until such time as the surrounding earth has become firm.

FILLING THE DITCH

As soon as the tile have been laid in the ditch, a few inches of earth should be placed over them, being careful not to change their alignment. This earth should be tamped sufficiently to hold the tile in place. The subsequent work of filling the ditch may be done in several ways. A team hitched to a plow carrying an evener nine or ten feet long so that a horse may walk on each side of the ditch may be utilized to plow the earth into the ditch. Or a road scraper drawn parallel with the drain and over the earth to be handled will soon fill the ditch; but it is not a serious task to do the work by hand.

DISTANCE APART OF LATERALS

There is no rule that can be laid down governing this part of the work. If the soil is sandy and open, the

laterals may properly be placed 100 feet or more apart; but if the soil is composed of clay or clay loam, it may be necessary to lay the laterals 40 to 50 feet apart. Much depends upon the conditions, and good judgment must be relied upon in this as in many other things about the farm.

NUMBER OF LINEAL FEET PER ACRE

The following table shows the number of feet of tile required per acre if the drains are laid the specified distances apart: —

20 feet apart	. . . . .	2205 feet
25 feet apart	. . . . .	1760 feet
30 feet apart	. . . . .	1470 feet
40 feet apart	. . . . .	1102 feet
50 feet apart	. . . . .	880 feet
100 feet apart	. . . . .	440 feet
150 feet apart	. . . . .	270 feet
200 feet apart	. . . . .	220 feet

There are two general types of tile on the market for use in drainage — the soft or brick tile and the hard or burned tile.

HARD vs. SOFT TILE

The use of soft tile for drains is not recommended, because the cost of hard tile is little, if any, more than of soft tile, while the advantages of the hard over the soft tile are many. Among these are greater durability, less liability to break in handling, less injury from frost, greater strength, etc. Good tile should ring when struck with a hammer.

COST OF DRAINAGE

Four-inch vitrified tile with collars, including the necessary Y's for laterals, should be obtained in most of the Eastern States for \$.05 per foot; three-inch lateral tile, $1\frac{1}{2}$ cents per foot.

The cost of installing a drainage system will depend on the price of labor, materials, and local conditions, but an average cost at the present time is about \$.45 per rod.

Good tile drains are a permanent improvement, and systems now working perfectly have been in use for seventy years. The general verdict of those who have had experience in the use of tile drainage is to the effect that an increased crop yield on the farm of from 50 to 100 per cent is the result.

NOTE.—A very exhaustive treatise on drainage may be found in Bulletin 254, issued by Agricultural Experiment Station of the College of Agriculture, Cornell University.

CHAPTER VI

COMMERCIAL FERTILIZERS

WHILE it is believed by the most advanced students of scientific agriculture that the true method of enriching the soil is to employ only such materials and such means as are available through proper and intelligent treatment of the soil itself, yet at the present time certain conditions seem to render necessary the introduction of extraneous substances into the soil to supply plant food when it is lacking. These substances are generally known as Commercial Fertilizers.

Next to the vast waste going on throughout the country in barnyard manure, comes the money loss and haphazard methods employed in the purchase and application of commercial fertilizers. The practice of purchasing and applying these commercial fertilizers is almost universal throughout the country, and a large proportion of them are purchased and applied without the slightest reference to their applicability to the particular soil treated or even to the crops to be raised.

Manufacturers of commercial fertilizers place upon the market hundreds of different brands, some valuable and some nearly worthless. Some are recommended as food for specified plants, while others are advertised as containing the proper compounds to cause any kind of

plant to grow and thrive. It is needless, perhaps, to state that commercial fertilizers are valuable only when they contain such ingredients as are lacking in the particular soil to be treated.

To illustrate: it is folly to purchase a fertilizer rich in nitrogen to be applied on muck land, because such land is already overrich in humus, and therefore presumably in nitrogen. Such soil is usually in need of lime, which is not considered a plant food in the ordinary sense, and the cost is only slight in comparison with the ingredients usually contained in commercial fertilizers.

Again, to illustrate: many manufacturers advertise a compound which is stated to be especially adapted to the raising of potato crops — high in percentages of phosphoric acid or potash. Potatoes, as is well known, require large quantities of phosphoric acid and potash, but whether the application of that compound to the particular potato crop is wise or foolish depends wholly on whether the soil is rich in those particular plant foods or is lacking in them.

Two prime factors must be known by the farmer who proposes to invest in commercial fertilizers before he can successfully and profitably take full advantage of such practice: first, he must know what plant food is lacking in his soil; second, he must be able to determine what plant food is contained in the advertised compound.

ANALYSIS OF FERTILIZERS

In the State of New York, as well as in many other States, laws have been placed upon the statute books which require every manufacturer and dealer in com-

mercial fertilizers to place upon the outside of every package the weight, brand, name and address of manufacturer, and the chemical composition of the compound, with the percentage of nitrogen, of available phosphoric acid, or total phosphoric acid, and of potash. The purpose of these laws is apparent: it is to enable the purchaser to know something of the constituents and value of the material in which he is investing his money.

In actual practice, however, while the requirements of the laws are generally complied with, the statement on the package tends more to confuse than to enlighten the buyer. It would require a student in chemistry, not a farmer, to properly understand the following formula, which is taken from a package of commercial fertilizer: —

Ammonia	2 to 3 per cent
Soluble phosphoric acid	6 to 7 per cent
Reverted phosphoric acid	2 to 3 per cent
Available phosphoric acid	8 to 10 per cent
Total phosphoric acid	10 to 12 per cent
Bone phosphate	22 to 26 per cent
Potash	2 to 3 per cent
Equal sulphate	3.7 to 5.0 per cent

Reduced to plain, intelligible language, it means this: —

Nitrogen	1.65 per cent
Available phosphoric acid	8 per cent
Potash	2 per cent

Manufacturers apparently strive to make their guarantees look formidable to the uninitiated, and it often happens that when the percentage of plant food is very low,

and the percentage of worthless filler is very high, the formidable looking bulk will sell.

To determine whether the price of a given fertilizer, judged by its guarantee, is fair and reasonable, we must know the value of its constituent parts, to wit, its nitrogen, its phosphoric acid, and its potash. To illustrate, suppose —

¹Nitrogen is worth about 14 cents a pound.

Phosphoric acid, 4 cents a pound.

Potash, $4\frac{1}{2}$ cents a pound.

The percentages given in the manufacturer's guarantee are the number of pounds of the several ingredients which appear in 100 pounds of fertilizer, and to arrive at the quantity in a ton, multiply this percentage by 20, because there are twenty hundred pounds in a ton. Thus it appears that the value of the actual plant food in the guarantee given above is as follows: —

20×1.65 equals 33 lbs. of nitrogen.

20×8 equals 160 lbs. of phosphoric acid.

20×2 equals 40 lbs. of potash.

To reduce this to dollars it is only necessary to multiply the quantity of the several ingredients by the price of each, thus: —

33 lbs. of nitrogen at \$.14 equals	\$ 4.62
160 lbs. of phosphoric acid at \$.04 equals	6.40
40 lbs. of potash at \$.045 equals	1.80
A total of	<u>\$12.82</u>

¹The price of these chemicals has advanced somewhat since this chapter was written.

This is the real value of a ton of commercial fertilizer which is quoted on the market at \$20.

If commercial fertilizers must be purchased, it is advisable to buy the nitrogen, the phosphoric acid, and the potash and mix them at home; the advantages thus secured are many: First. The purchaser then knows just what he is paying for. Second. He can mix the ingredients in such proportions as the soil requires. Third. If he wishes to use fillers or make weight, he can use fine road dust, ground muck, land plaster, or other material, and thereby save freight charges. The task of mixing is not difficult, while \$8 per ton may be saved.

LACK OF PLANT FOOD IN THE SOIL

It is utterly impossible to make any formula or lay down a set of rules whereby it can be determined, even approximately, what particular plant foods should be applied to any specific soil. Actual experience in any given locality must be the guide. A soil may be rich in most of the plant foods and still be unproductive, because there is lacking some one essential which, if known, might be easily supplied.

Also, a soil may be rich in all of the plant foods and still be unproductive because of acidity, lack of air or moisture, or other unfavorable physical conditions. The wise husbandman will determine for himself by intelligent experiment what his soil requires and what crop it is best fitted to produce, and then, if he learns to mix his own fertilizers, he is in the best possible position to make his experiments valuable.

CHAPTER VII

APPLICATION OF FERTILIZERS

It is a self-evident fact that soil fertility would remain unchanged if all the ingredients removed by crop products as well as those lost by soil washing, chemical action, and evaporation were restored to the land in the form of manures. That this is not done is the usual cause of soil exhaustion and resultant crop failures. The system of so-called grain farming which is still practiced over a large area of the United States is certain to result in soil exhaustion, in spite of the fact that those soils were originally the richest and most fertile to be found. The growing of cotton and tobacco in the South and wheat and corn in the West for a series of years without returning to the soil a proper equivalent for the constituents removed by the crops has already resulted in soil exhaustion that is quite startling in extent, and each year crop yields are less per acre and crop failures more frequent and far-reaching.

It should not be forgotten that "the soil is the farmer's bank," and if he constantly draws out and never puts in, he will soon come to the end of his account. On the other hand, it is a well-known fact that men engaged in market gardening, fruit growing, and dairying have frequently increased the fertility of their soil, while at the same time largely increasing their crop yield.

In order that the farmer may know the value of his manure, the following table is given, showing the amount of fertilizing constituents in one ton of various agricultural products, if returned to the land in the form of manure:—

FARM PRODUCTS	NITROGEN	PHOSPHO- RIC ACID	POTASH
Timothy hay	19.2	7.2	25.2
Clover hay	39.4	8.0	35.0
Alfalfa hay	53.2	10.8	49.2
Cowpea hay	79.6	13.2	47.2
Field corn fodder	17.2	7.2	21.4
Corn silage	8.4	2.4	6.6
Wheat straw	8.6	2.6	14.8
Rye straw	10.0	5.8	15.8
Oat straw	13.0	4.4	24.4
Wheat	34.6	19.2	7.0
Rye	32.4	16.2	10.4
Oats	36.2	15.4	11.4
Corn	29.6	12.2	7.2
Barley	39.6	15.4	9.0
Wheat bran	51.2	58.4	31.4
Linseed meal	108.6	37.6	26.2
Cotton seed meal	142.8	61.8	36.4
Potatoes	7.0	3.2	11.4
Milk	10.2	3.4	3.0

The importance of this table will appear when we come to consider the various fertilizing constituents required by the usual farm crops.

FERTILIZERS REQUIRED BY DIFFERENT SOILS AND CROPS

The *essential* constituents of plant food in the soil are nitrogen, phosphoric acid, and potash, and the value of manure or commercial fertilizers is determined always by the quantity of these constituents which they contain.

DIFFERENCE IN SOILS

Soils differ in their requirements of specific plant foods, owing to their different formations and to the different systems of cropping to which they have been subjected. A sandy soil is usually deficient in all of the essential plant foods, while a clay soil is usually supplied with an abundance of potash and often with phosphoric acid, especially if there is a limestone subsoil. Soil rich in humus is usually rich in nitrogen, but frequently is poor in potash and also in phosphoric acid. So it will be seen that soils which have never been cropped may differ materially in their essential elements of plant food.

Again, if such soils have been subjected to a one-crop system for a period of several years, it is certain to become depleted in the plant food most necessary to that crop, and if its productiveness is to be restored, the essential in which it is lacking must first be returned to the soil.

HOW MAY THE ESSENTIALS BE RETURNED TO THE SOIL

If the soil is lacking in nitrogen, it is evident that only crops should be planted which are able to thrive by procuring their nitrogen from other sources than the soil. The legumes belong to this class and include the various clovers, peas, beans, vetches, etc., which differ from other

plants in being able, under proper conditions, to acquire the necessary nitrogen from the air by the aid of minute organisms working in their root tubercles, and can therefore make perfect growth without depending upon the nitrogen of the soil. Hence to supply nitrogen to the legumes would be unnecessary as well as wasteful, as the air furnishes to these plants without cost all that they require.

On the other hand, the grasses require generous applications of nitrogen during their period of rapid growth, in order to attain their maximum development.

FERTILIZING MATERIALS

“Form” as applied to a fertilizing constituent has reference to its combination with other elements. The condition of the element, or constituent part, has also an important bearing upon its availability and value as plant food. Many materials containing essential elements are practically worthless as plant food because the form is such that plants cannot use them; such materials are called “unavailable.” In certain cases proper treatment will so change the form as to render them available and hence valuable for plant food.

NITROGEN

Nitrogen is found in fertilizers in three distinct forms, viz.: Organic matter, ammonia and nitrate.

ORGANIC NITROGEN

Every form of life, whether animal or vegetable, contains nitrogen in combination with other elements, and its

value as plant food depends upon the rapidity with which the substance will decay, as decay it must before its form can be changed so that it will become available for plant food. Some forms of organic matter are very dense and are slow to decay, such as horns, hoofs and green bone. Other forms, such as dried blood, ground dried meat, tankage, and the refuse from fish canning establishments, decay very readily under favorable conditions and become available for plant food.

The process of decay of nitrogenous organic matter tends to dissolve various mineral ingredients in the soil, and hence we find the available phosphoric acid, potash, and lime content somewhat increased.

NITROGEN AND AMMONIA

This form is usually found in commercial fertilizers as sulphate of ammonia and is more readily available than organic forms of nitrogen. These forms are generally used in compounding commercial fertilizers, are highly concentrated, contain about 20 per cent of nitrogen, are readily converted into nitrates, and hence become available for plant food. If large quantities of this element are used, the tendency will be to increase the acidity of the soil, because the ammonia is more readily taken up by the plants than the sulphuric acid, which latter accumulates in and near the surface of the soil. This condition, if found to exist, must be corrected by applications of lime.

NITRATES

Nitrates are found in commercial fertilizers as nitrate of soda, nitrate of potash, etc. This form of nitrogen is

immediately available as plant food, is instantly soluble in water, diffuses readily through the soil, and if the soil is open or porous, is liable to be washed out unless the plant roots are ready to promptly receive it.

It appears from the foregoing that crops requiring to grow to maturity, and especially if the soil is open, should be treated with some form of organic nitrogen which, in the process of decay, forms ammonia which readily combines with other mineral elements of the soil to form nitrates, thus becoming available for plant food.

Crops which mature quickly may be very highly developed by an application of nitrogen as nitrates, while the crop is in the early stages of development, provided the other soil conditions are favorable. In actual practice there is always some loss of nitrogen. Plants seldom if ever secure the full benefit of the plant foods offered to them. Ammonia is nitrified in the soil, and the change involves loss.

Nitrate nitrogen is liable to be washed out of the soil, or washed into the subsoil, out of reach of the plant roots. Whatever the conditions, let it be remembered that nitrogen in some form must be supplied as food to every growing plant.

PHOSPHORIC ACID

Phosphoric acid is derived from substances called phosphates and is found in combination with lime, iron, and alumina. Phosphate of lime is, however, the principal source from which the phosphoric acid of commercial fertilizers is derived, and as such it occurs in three forms: first, soluble in water and available for plant food; second,

slowly soluble in water but still available, and commercially known as "reverted"; third, insoluble in water and unavailable, or very slowly available, as plant food. Certain other forms also should be mentioned, such as slag, floats, and certain salts, which, by various kinds of treatment, become more or less valuable as plant food.

ORGANIC PHOSPHATES

Certain organic matter also contains phosphates, such as ground, burned, boiled, or steamed bone; also tankage and waste material from rendering establishments. All of the organic phosphates contain more or less organic matter and are usually associated with a percentage of nitrogen, while the mineral phosphates contain no organic matter. Rock deposits in South Carolina, Florida, and Tennessee supply a large part of the phosphates used in commercial fertilizers.

The soluble phosphates are derived from the insoluble materials by grinding the rock or bone to a powder which is mixed with sulphuric acid, thus changing the insoluble to the soluble form, known as superphosphates, which usually contain about 15 per cent of soluble phosphoric acid.

USE OF PHOSPHORIC ACID

The use of phosphoric acid must be governed not alone by its origin and form, but also by soil conditions, climate, and the crop to be grown. If the soil is lacking in lime, there is always more or less danger that a portion of the phosphoric acid will unite with compounds of iron and alumina and become "fixed" in the surface of the soil, producing a sour condition. If so, this condition

must be changed by the application of lime. In soils well provided with lime the soluble phosphoric acid is "fixed," but largely in the form of "reverted" lime phosphate. While this is available, it does not produce the sour condition just mentioned.

The best results from the use of superphosphates are secured when they are applied on heavy, fine-grained soils, such as clay loams; but good results may also be obtained on light, sandy soils, provided there is present a good supply of humus and barnyard manure.

POTASH

Potash as it exists in commercial fertilizers is usually found as chlorides, or muriates, and is combined with chlorine or sulphate, in which the potash is combined with sulphuric acid. All forms of potash are freely soluble in water and available for plant food. Certain crops, however, seem to be favorably affected and others unfavorably by applications of one or another of the forms of potash. To illustrate: potatoes and tobacco are unfavorably influenced by the use of muriate of potash, while the same crops show very favorable results where materials free from chlorides are used.

SOURCES OF POTASH

The potash mines in the north of Germany supply the kainit, sylvinite, muriate, and sulphate used in this country in the manufacture of potash for commercial fertilizers.

USE OF POTASH

Light, sandy soils, well filled with humus, respond readily to applications of potash, and still better results

are obtained if the soil is well supplied with lime, because the lime tends to "fix" the potash and retain it near the surface of the ground. Even heavy clay soils that are well supplied with lime retain the potash near the surface and show most favorable results.

Potash can be used to good advantage on reclaimed swamps and marsh lands, but it is believed that potash in the form of sulphate is preferable for this kind of soil.

Root crops, such as potatoes, beets, and mangels, are highly benefited by the application of potash in large quantities, and it is believed to be the better practice to apply it a considerable time before the crop is planted.

It should not be forgotten that large and frequent applications of potash tend to reduce the lime content in the soil by forming lime chloride, which is readily washed out of the soil. To correct this tendency frequent applications of lime should be made.

WHAT FERTILIZERS TO USE

Various conditions must be taken into account in determining the kind of fertilizers to use in preparing for a crop — the character of the soil, whether light, sandy, and porous, or heavy and close-textured; whether or not the soil is well supplied with humus and lime, and also the kind of crop in view. If the soil is poor in humus, the application of materials rich in nitrogen will be found beneficial, while if the soil is well supplied with humus, better results will follow the application of phosphates and potash. As a general proposition it may be laid down that the legumes require heavy applications of potash and sulphuric acid and little nitrogen; that the

root crops, such as sugar beets and mangels, require plenty of nitrogen. Turnips and potatoes require phosphates and potash. Fruit trees do not require soluble, quick-acting fertilizers as they are slow-growing. A mixture of ground bone and muriate of potash is a satisfactory treatment for them, especially if the mixture be applied to clover and then plowed under.

Unlike potatoes, corn requires large quantities of nitrogen for its best development, and it also uses to good advantage potash and sulphates, while it is always benefited by applications of barnyard manure.

Wheat, oats, and hay crops may be considered largely in the same class as corn, so far as actual plant food requirements go. Specific suggestions will be given regarding each in the chapters treating upon those subjects.

FERTILIZING MATERIAL	NITROGEN	PHOSPHORIC ACID			POTASH	CHLORIN
		Available	Insoluble	Total		
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Supplying nitrogen:	15.5-16.0	.	.	.	.	.
Nitrate of soda	19.0-20.5	.	.	.	.	.
Sulphate of ammonia	12.0-14.0	.	.	3.0-5.0	.	.
Dried blood (high grade)	10.0-11.0	.	.	1.0-2.0	.	.
Dried blood (low grade)	11.0-12.5	.	.	11.0-14.0	.	.
Concentrated tankage	5.0-6.0	.	.	6.0-8.0	.	.
Tankage (bone)	7.0-9.0	.	.	1.5-2.0	2-3.0	.
Dried fish scrap	6.5-7.5	.	.	1.0-1.5	1-1.5	.
Cotton-seed meal	5.0-6.0	.	.	.	.	.
Castor pomace . . . . .	.	.	26-28	26.0-28.0	.	.
Supplying phosphoric acid:	.	.	.	.	.	.
South Carolina rock phosphate . . . . .	.	.	.	.	.	.
South Carolina rock superphosphate (dissolved South Carolina rock phosphate) . . . . .	.	12-15	1-3	13.0-16.0	.	.
Florida land rock phosphate . . . . .	.	.	33-35	33.0-35.0	.	.
Florida pebble phosphate . . . . .	.	.	26-32	26.0-32.0	.	.
Florida superphosphate (dissolved Florida phosphate) . . . . .	.	14-16	1-4	16.0-20.0	.	.
Boneblack . . . . .	.	.	32-36	32.0-36.0	.	.
Boneblack superphosphate (dissolved boneblack) . . . . .	.	15-17	1-2	17.0-18.0	.	.
Ground bone	2.5-4.5	5-8	15-17	20.0-25.0	.	.
Steamed bone	1.5-2.5	6-9	16-20	22.0-29.0	.	.
Dissolved bone	2.0-3.0	13-15	2-3	15.0-17.0	.	.
Thomas slag . . . . .	.	.	.	11.4-23.0	.	.
Supplying potash:	.	.	.	.	.	.
Muriate of potash . . . . .	.	.	.	.	48-52.0	45.0-48.0
Sulphate of potash (high grade) . . . . .	.	.	.	.	48-52.0	1.5-1.5
Sulphate of potash and magnesia . . . . .	.	.	.	.	26-30.0	1.5-2.5
Kainit . . . . .	.	.	.	.	12-12.5	30.0-32.0
Sylvinit . . . . .	.	.	.	.	16-20.0	42.0-46.0
Cotton-hull ashes . . . . .	.	.	.	7.0-9.0	20-30.0	.
Wood ashes (unleached) . . . . .	.	.	.	1.0-2.0	2-8.0	.
Wood ashes (leached) . . . . .	.	.	.	1.0-1.5	1-2.0	.
Tobacco stems	2.0-3.0	.	.	3.0-5.0	5-8.0	.

CHAPTER VIII

LIME

THE practice of applying lime to the soil is very ancient and has been followed in many of the countries of Europe for centuries, and yet it is only recently that its real value as an agent for soil improvement has been fully recognized. While the effect of lime when applied to soil is indicated by the growing crop and has been common knowledge for many generations, it is only within comparatively recent years that a thorough understanding of the actual workings and chemical changes which take place in the soil through the presence of lime has been gained.

Authorities seem to agree that lime is a necessary ingredient of the soil for proper plant development, and that without it plants cannot thrive, even where there is an abundance of all the other essential elements of plant food. It is fortunate, therefore, that nature has provided an abundance of lime in many soils so that its artificial use is unnecessary. If nature has furnished a bountiful supply of lime, it is utter folly to attempt to add to it artificially. On the other hand, if soil is naturally deficient in lime, it would be equally unwise not to supply it artificially. These truths are self-evident. Many soils

we know are deficient in lime, such as granite formations, soils derived from mica-schist, sandstone, slates, and shales, as well as swamps and peat-bogs. Many other soils, which were originally well supplied with lime, have been deprived of it through chemical combinations during years of cropping and also by being washed out of the soil in the form of carbonate of lime. Whatever may have been the cause of the deficiency, if lime is absent, the result is sour land, as it is termed. Such a soil contains a surplus of acids that are poisonous to most plants and presents a condition which denies to the plant roots the food which is actually stored in the soil.

CAUSE OF ACID IN THE SOIL

It is believed by some authorities that the presence of the acids found in sour soils which have been cropped for many years may be accounted for by the fact that plants as well as animals throw off waste materials which are always more or less poisonous — the animal from the lungs and the pores of the skin, and the plant from the roots, fibers, and tissues. If this theory is correct, it would explain to some extent the presence of acids in soils that have been continuously cropped for many years, and the further fact that the same crop repeated year after year upon the same soil will finally refuse to grow because of the accumulation of acid.

TESTING THE SOIL

To determine the amount of lime contained in soil, the chemist usually treats a sample with strong mineral acid (such as hydrochloric), and if the amount of lime

thus dissolved is less than one per cent, immediate resort to liming is necessary. The practical farmer may test his soil in a much simpler manner. Small pieces of litmus paper may be inserted into the soil in various parts of the field while the soil is damp, and if red spots appear on the paper, it indicates the presence of harmful acids. Another practical method of determining whether the soil requires lime, is to apply 40 pounds of lime to a small plat of about 12×30 feet and leave an adjoining plat of the same size untreated; then plant both plats with beets. The resultant crop should determine whether or not the soil requires lime.

THE ACTION OF LIME ON SOILS

Lime is said to liberate the potash in the soil and render it available for plant food. In this particular, gypsum (land plaster) is believed to act more energetically than carbonate of lime, air-slaked or water-slaked (hydrated) lime.

When soluble phosphates are applied to soils deficient in lime, the phosphoric acid combines with the iron and alumina in the soil and becomes "fixed"; that is to say, unavailable for plant food. If, however, the soil contains lime, this combination is prevented, or at least retarded, and the plant is afforded an opportunity to assimilate the phosphoric acid before it becomes "fixed."

TWOFOLD EFFECTS OF LIME

Lime, therefore, when applied to soil requiring it, has the effect, first, of neutralizing the acids that are harmful to plants; and, second, of liberating the locked-up or

“fixed” plant foods and rendering them available for the use of plants.



EFFECTS OF LIME ON THE WORK OF ORGANISMS IN THE SOIL

The soil contains millions of germs and bacteria so minute that they are visible only under the microscope. Their functions seem to be largely to change organic matter and nitrogen into nitrates, ready for the use of plants. This change is known as “nitrofaction,” and by some not fully understood process is vastly promoted by the presence of lime. It is believed that these minute organisms are not able to live in a sour soil, and that the lime so neutralizes the acids as to make it possible for them to thrive and perform their useful work.

TOO MUCH LIME DANGEROUS

The direct effect of lime when applied to the soil is to cause such activity among the microorganisms that rapid decay of all the organic matter in the soil takes

place. This chemical change will, of course, largely increase the growing crop and also will rapidly deplete the fertility of the soil. Hence, it is of the utmost importance that the fertility of the soil should be maintained by frequent applications of barnyard manure or green manure so as to maintain the proper quantity of humus. If this is not done, the soil will soon be found poorer than it was before lime was applied. Where, however, there is an abundance of humus, and especially upon muck and swamp land, there is little danger of weakening the soil by adding lime.

In short, all the essential elements must be maintained in the soil if continuous good crops are to be obtained.

PLANTS MOST BENEFITED BY LIME

Experiments at the Rhode Island Agricultural Experiment Station have proved that the following named plants have shown marked improvement from the use of lime: spinach, lettuce, beets, okra, vegetable oyster, celery, onion, parsnip, cauliflower, cucumber, eggplant, canteloupe asparagus, kohl-rabi, cabbage, Swedish turnip, pepper, rhubarb, common pea, pumpkin, summer squash, wax bean, red valentine bean, bush lima bean, lentil, hubbard squash, saltbush, hemp, tobacco, sorghum, alfalfa, red, white, crimson, and alsike clover, barley, emmer, wheat, oats, timothy, Kentucky bluegrass, Canada pea, Cuthbert raspberry, gooseberry, currant, orange, quince, cherry, Burbank Japan plum, American linden, American elm, sweet allyssum, mignonette, nasturtium, balsam, pansy, poppy, and sweet pea. Not only were most of these crops largely increased by the use of

lime, but they were ready for market much earlier than where lime was not used.



CROPS SLIGHTLY BENEFITED BY LIME

Indian corn, spurry, rye, carrot, chicory, Rhode Island bent, and red top.

It is very questionable whether it is wise to use lime in the raising of potatoes. While it is possible that the size of the tubers may be increased, it is quite likely also to add to the danger from the disease known as "scab."

OTHER PLANTS INJURED BY LIME

Cotton, tomato, cowpea, zinnia, phlox, Concord grape, peach, apple, pear, lupine, sorrel, radish, velvet bean, flax, castor bean, blackberry, black-cap raspberry, cranberry, Norway spruce, watermelon, and American white birch.

It is plain then that lime, like all the other essential

elements of the soil, should be used intelligently and with a knowledge of all the conditions and plant requirements.



HOW TO APPLY LIME

If quicklime is to be used, the experience of the writer leads to the belief that the best and most satisfactory way to apply it to the soil is by the use of a plaster sower, and immediately after the field is plowed; then follow with the harrow until the lime is thoroughly and evenly mixed with the soil. Several tons of the lime may be placed upon a large platform near a brook or spring, in the field, and after a few barrels of water are thrown over the mass and the process of slaking is started, it may be left until the next day, when the air will have practically completed the work and the pile will be nearly as fine as flour, ready to be placed in the plaster sower and spread upon the land. It should be screened as used, and any unslaked pieces can be reduced by the addition of a little more water.

QUANTITY OF LIME PER ACRE

Of course the quantity of lime to be applied to an acre of land must depend upon the condition of the soil and to some extent upon the kind of crop to be planted.

Alfalfa and clover crops should receive much larger quantities than oats, wheat, and similar grains — usually about one ton per acre. In fact, all the legumes are generally large consumers of lime, while the non-legumes require less. Besides the character of the soil and the kind of crop to be grown, there is also the question of frequency of application. Usually once in five or six years will be sufficient, but this must also be decided with reference to the condition of the soil, the kind of crop, and the quantity to be applied. It is believed that it is better practice to make light applications and frequently, rather than heavy applications at long intervals.

FORMS OF LIME

There are various forms of lime which may be obtained, which differ principally only in price and in the per cent of actual lime. As lime is a very heavy substance at best, the question of freight charges must always be considered in this connection.

Quicklime should contain about 90 to 95 per cent of actual lime (CaO), and is the most concentrated form of the material, consequently the most convenient to handle.

There are also gypsum, or land plaster, in which the lime is in the form of a mild sulphate; ground limestone, or agricultural lime, as it is called, in which the lime is in the form of a mild carbonate; and marl, which is so uncertain in its composition that the percentage of lime may vary from 5 to 90 per cent. Wood ashes contain from 30 to 35 per cent of carbonate, and limekiln ashes 40 per cent of lime.

In conclusion it may be said that the first step in pro-

viding soil with lime is to ascertain whether or not it is necessary. If it is, apply it judiciously. Never depend upon lime alone to maintain the fertility of soil, because, as has so often been shown, all of the essential elements necessary for plant development must be present if a profitable crop is to be secured.

EFFECTS OF LIME ON DIFFERENT CROPS

(See Plates.)

CHAPTER IX

HOW PLANTS GROW

ALL plants are divided into leaf, stem, and root, and the structure of each of these parts is adapted to the kind and requirements of each plant.

THE ROOT

The chief purpose of plant roots is to search for and secure moisture. In the performance of this work they show such wonderful adaptability and power that it is not a great flight of imagination to attribute to them some degree of intelligence.

Soil moisture is stored below the surface of the ground, and plant roots are guided, or force their way, unerringly downward towards it. There are two principal kinds of roots: the taproot which goes deep into the subsoil, and the lateral roots which spread out in a mass near the surface. The taproot also sends out lateral rootlets at frequent intervals in the course of its descent, which largely increase the food area of the plant. The end, or extreme point of this root, is protected by a hard and sharp cap, which is forced by the pressure from above between the soil particles and even through clay and hardpan in its downward search for water.

Why does water attract plant roots?

How do plants know in what direction to go for water?

These are apparently simple questions, but as yet they are unanswered.

The roots of trees have been found in cisterns 200 feet from the tree. In the construction of a tunnel not long ago, workmen found the roots of alfalfa which had penetrated through 40 feet of the hill above and were enjoying the water in a rock fissure at that depth.

The principal roots of trees growing near a stream always point toward the water. How do they know where the water is, and why do they know it? Very interesting questions which afford food for thought.

Nor is the work performed by roots in their search for water in the soil the most wonderful thing to be learned about them. The total length of all the roots and filaments composing the root system of a healthy corn plant has been estimated at a quarter of a mile, while measurements made on a squash vine showed its roots to be 15 miles in length, and they had actually grown at the astounding rate of 1000 feet a day.

While plant roots show such a powerful tendency in searching for and securing water, it is also true that air is about equally essential to their proper development. Their best work is performed in soil in which the water is held in a thin film surrounding the soil particles while still admitting air among them. In this condition the roots, rootlets, and root hairs energetically force themselves among the particles and absorb the moisture by means of water-attracting qualities in the root hairs. As each tiny particle of soil is relieved of its water film and each little reservoir is emptied, the surrounding water flows in, and this is in turn taken up by the plant.

SOIL WATER

Not only do plants require large quantities of water, but all their food is acquired through the medium of soil moisture, or soil water. The nitrogen, the phosphoric acid, and the potash must all first be dissolved in the soil water before the plant can use them. In other words, plant food must first become soluble before it can be useful.

Why does the soil water containing the plant foods apparently defy the law of gravitation and rise in the stem of the plant and to the top of the tallest trees? Many theories have been advanced to explain this wonderful phenomena, but as yet it is only theory. It has been claimed by some authorities that the action of air bubbles in the roots would force the water upward; by others that barometric pressure would accomplish the work; by others that capillarity would do it; while the latest experts in the field have advanced the theory that leaves contain some substance which is actually able to draw the water up from the roots through the stem or trunk for their use at the top. This process is known as "Osmosis"; but a little reflection will convince any one that this theory will not hold good. If osmosis is the result of leaf-pull, why is it that the sap of a maple tree rushes to its very top in the springtime, before there is a leaf on the tree? And why does the stump of a grape vine continue to bleed?

PLANT CELLS

What is actually known is that the soil water, or sap, passes upward through a series of cells and ducts of

varying sizes and shapes, depositing its plant food throughout the plant system, enlarging, adding cell upon cell, and finally reaching the leaves, where the surplus moisture is liberated through the leaf pores in the form of oxygen. In many respects the process by which the plant breathes and lives is analogous to that of the animal kingdom.

THE "BIG FOUR"

From a study of the foregoing chapters it must be clear that for the best development in plant life there must be four principal conditions present, which we will call "the big four": —

First, plenty of soil moisture.

Second, plenty of air in the soil.

Third, plenty of plant food.

Fourth, plenty of sunlight.

CHAPTER X

THE ROOT SYSTEMS OF FIELD CROPS

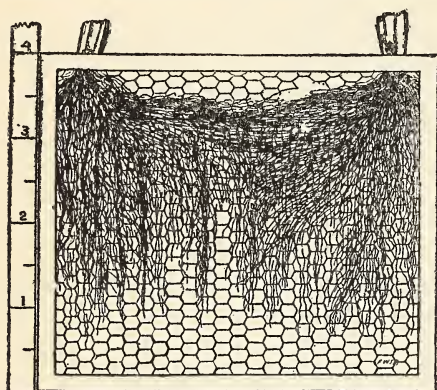
THE direct intent and bearing of the preceding chapters has been to bring the student and farmer to a full realization of the importance of a proper condition of the soil for the reception of the roots of growing plants. To further impress this feature of the subject upon the mind of every reader, this chapter will illustrate how the roots of plants develop in the soil and how they may be affected by proper or improper cultivation.

The root systems of our cultivated plants bear a most important relation to the cultivation of the crops, the application of fertilizers and the moisture content of the soil; and in order to fully understand the reasons for the different cultural practices it is necessary to know to what extent and in what way the roots of the various crops develop.

One of the surprising things which is met with in any agricultural community is the lack of knowledge concerning the roots of plants grown year after year by the farmer; and it frequently happens that he is the most surprised of all men when told of the wonderful development of the roots of the plant with which he is most familiar.

In order to study the natural distribution of the roots of different field crops as they exist in the soil, it is neces-

sary to remove the earth from around and among them in such a way as to leave the roots not only intact, but also in the same position which they occupied while the plant was growing. This is accomplished by digging a trench about the plant two or three feet wide and several feet deep, and fitting an iron frame over this block of earth.



Root system of corn plant.

and several iron rods with sharpened ends are driven through the earth laterally in various directions and the ends secured in the frame. This arrangement of the rods is such that when the block of earth is removed the roots and root fibers are

held in practically the same positions they occupied in the soil when growing. The soil is then slowly and carefully washed away by the aid of a small force pump and the roots left suspended among the iron rods.

Another method employed is to sink a cage into an excavation, and after the excavation has been refilled with earth, the plant is started and grown in the usual way. In the fall the cage is removed and the earth washed out, as before stated, leaving the roots and fibers in the position they held when growing.

CORN ROOT SYSTEM

At the Wisconsin Station samples of corn taken 42 days after planting, when the plants were 18 inches high, showed that the roots of two hills met and passed each other in the center of the rows $3\frac{1}{2}$ feet apart, and had penetrated the soil to a depth of 18 inches. The surface roots sloped gently downward toward the center of the row, where they were about 8 inches below the surface. When the corn was 3 feet high, the roots were found to occupy the entire soil down to a depth of 2 feet, while the surface laterals descended in a gentle curve towards the center of the row and passed one another at a depth of 6 inches. A third sample, taken when the corn was coming into full tassel, showed that the roots had fully occupied the upper 3 feet of soil in the entire field, and that the surface laterals were then within 5 inches of the surface. At maturity the roots extended fully 4 feet into the soil and the laterals were within 4 inches of the surface of the ground.

In studying the total root distribution of corn from 9 to 27 days old, it was found that at the end of 9 days some of the roots had extended laterally to a distance of 16 inches, and that some had reached a depth of 8 inches, while no root was nearer the surface than 5 inches at 6 inches from the plant. Eighteen days after planting, the lateral roots had grown to a length of 18 inches, the taproots extended downward 12 inches, and there were no roots nearer the surface than 2 inches at 6 inches from the plant. In 27 days the roots had reached a depth of 18 inches, laterals 24 inches in length and 4 inches below the surface.

In some other experiments made by the North Dakota Station, the Colorado Station, and the Kansas Station, it appeared that the roots of corn penetrate the soil to a depth of from 3 to 8 feet and that the laterals completely fill the soil, spreading 5 to 6 feet from the stalk and coming to within 4 inches of the surface.

These experiments further show that the roots of corn and all other cultivated plants spread out farther than those of wheat, oats, and barley, but do not penetrate the soil so deeply. The experiments further demonstrate the fact that deep cultivation should not be practiced, especially after the crop has attained any considerable size, because the lateral roots will surely be cut off and the plant injured. Shallow and frequent cultivation should be the rule, and the cultivator should run a little farther from the plants at each successive cultivation.

POTATO ROOT SYSTEM

Potatoes are not a deep-rooted plant as compared with various other cultivated crops. Late potatoes, however, root much deeper than early varieties, sometimes reaching a depth of 3 feet; but the lateral roots of potatoes fill the whole soil area to within $2\frac{1}{2}$ inches of the surface and interlace from hill to hill. Under these conditions it would be folly to practice deep cultivation. Indeed, extended experiments amply prove the advantages of shallow cultivation for the best results.

Wheat roots examined 110 days after sowing were found to extend downward 4 feet; oats, 4 feet; winter rye, 3 feet; flax 3 to 4 feet, and all throwing out laterals until the soil area was completely filled. Brown grass

roots reach a depth of $5\frac{1}{2}$ feet, and timothy frequently deeper. Alfalfa is the deepest-rooted plant cultivated.



Root system of potato plant.

This plant is believed to have been originally a desert native, and its capacity to penetrate the soil for water is wonderful. If the water table is low enough to permit,

it is not uncommon to find alfalfa roots 10, 15, and sometimes 20 feet below the surface of the ground. Red clover reaches a depth of 4 feet, and crimson clover will often penetrate to a depth of 3 feet in its first season.

The foregoing facts show conclusively several things that are of practical interest and benefit to the farmer:—

First. Plant roots require conditions permitting deep penetration of the soil; hence, deep plowing is desirable.

Second. The roots occupy the whole soil area; therefore the whole soil should be thoroughly and properly prepared for the crop.

Third. The lateral roots grow close to the surface, and will therefore be injured if deep cultivation is practiced.

Fourth. The water table should be at least 4 feet below the surface, because the plant roots will stop when the water table is reached; hence the advantage of under drainage.

From the above facts it will be clearly seen that alfalfa cannot be successfully cultivated unless the soil is naturally dry and has a low water table; or, if not naturally drained, then tile drainage must be resorted to.

CHAPTER XI

LEGUMES

ALL of the legume family have the distinctive ability to procure nitrogen from the air and appropriate it to their own use. This operation seems to be accomplished through the aid of the microscopic germs or bacteria which burrow into the roots of the plants and form nodules or tubercles, and there change the various forms of nitrogen found in the soil as well as the nitrogen from the air into nitrates for the use of the plants. Just how these minute germs are able to extract the nitrogen from the air and deliver it to the plant, or what proportion so delivered is obtained from the air and what from the soil, is not known, but certain it is that soil upon which such crops are grown seems to increase its store of nitrogen from year to year, notwithstanding the growth and removal of large yearly crops.

To illustrate: a successful alfalfa field will produce at least 5 tons per acre of hay each season for 10 years or more, without the application of any kind of fertilizer whatever, and at the end of that period, if the field is plowed and planted with corn, the crop is likely to be much larger than was ever grown upon that field before,

and yet corn requires large quantities of nitrogen to properly develop.

Legumes, then, are regarded as the farmer's best friend, because they are able to supply without cost the most valuable of plant foods — nitrogen. The legume family comprises the several clovers, peas, beans, alfalfa, vetches, and others, all of which will now be considered.

ALFALFA

The origin of this plant appears to have been in the southwest part of Central Asia. Its name is of Arabic origin and means "the best fodder." It was cultivated by the Greeks 500 years B.C., and Roman writers gave fairly good directions for its cultivation. It was brought by the Spaniards to Old Mexico, but not until 1854 did it reach the United States by way of San Francisco from Chili. Its great value in the irrigated sections of the West soon brought it into general notice, since which time its culture has not only been extended to the non-irrigated regions of the West, but to almost every State in the Union. It is believed that no other plant has so rapidly increased in popularity, acreage, and commercial value since its introduction into this country as alfalfa.

DESCRIPTION

It is a deep-rooted, long-lived, herbaceous forage plant. Its flower is violet in color, clover shaped, and is borne in clusters. Its most important characteristic is its long taproot, which often penetrates 15 to 20 feet into the soil. This enables it to find stores of plant food in the soil



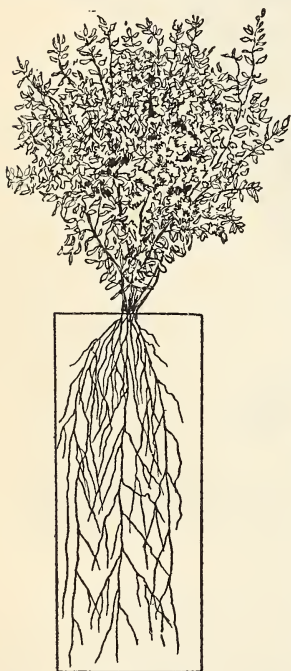
Alfalfa plant.

which cannot be reached by the shallow-rooted plants, and also enables it to withstand long periods of drought which would prove fatal to many crops.

ADAPTABILITY TO VARIOUS CONDITIONS

Alfalfa seems to adapt itself to a very wide range of countries and climates in various parts of the world. It grows below the sea level in California, and 8000 feet above the sea in Colorado. It yields abundant crops in the irrigated deserts of Arizona, one of the hottest regions

in the world, and thrives well and withstands the winters in New York State. It succeeds where the annual rainfall is only 14 inches, in semiarid regions, as also in the Gulf States, where the rainfall is 65 inches. And yet the most careful treatment and favorable conditions must be given to the young plants, at least in the Eastern States, in order to attain success in its cultivation.



Alfalfa root system in soil well drained and low water table.

CONDITIONS NECESSARY FOR SUCCESS

A deep, fertile, well-drained soil, rich in humus and containing an abundance of lime, with freedom from weeds, is necessary for alfalfa. The lack of any one of these conditions is very apt to cause failure of the crop in the Eastern States, where it is always produced under some disadvantages.

BARNYARD MANURE FOR ALFALFA

The best fertilizer to apply upon land preceding the seeding of alfalfa is barnyard manure, well rotted when applied. If fresh manure is used, it is better to apply it to the preceding crop, which will give time to destroy the germinating weed seeds by cultivation. The soil may be

enriched by plowing under some green crop, such as clover, cowpeas, or vetches. This treatment should also be followed by some other crop before alfalfa is sown, because the decaying vines are likely to produce acid conditions in the soil which are unfavorable to alfalfa plants.

COMMERCIAL FERTILIZERS FOR ALFALFA

If neither barnyard manure nor green manure is available, it will be necessary to resort to the use of a commercial fertilizer. This should be a mixture rich in phosphoric acid and potash, but need contain only a little nitrogen, because, as before stated, the plant being a legume, it will be able to secure its own supply of that element.



GOOD DRAINAGE NECESSARY

One of the most important conditions, and perhaps the most important, for successful alfalfa growing is good drainage. Badly drained soil is usually more or less sour, and land acids are death to the plant.

Alfalfa root system on poorly drained land and high water table. Under these conditions the plant will soon die.

The soil must be well drained and also have a low water table, for it is a deep-rooted plant, and the roots, as before explained, will stop when they reach water. A homely but forcible expression in this connection is sometimes heard: "Alfalfa can't stand wet feet." Neither can alfalfa withstand more than 24 hours of complete submergence in surface water during the growing season; but this condition might exist for several days in the winter, when the plant is dormant, without injury.

LIME ESSENTIAL TO ALFALFA

No other forage crop requires so much lime in the soil as alfalfa. While lime is not generally considered one of the essential plant foods for many kinds of plants, yet there is strong evidence to prove that lime is essential to the growth of alfalfa and to a less degree to the other members of the legume family.

Alfalfa refuses to grow and properly develop in soil that is devoid of lime. A chemical analysis of alfalfa shows the presence of 34.9 per cent of lime as against 4.7 per cent for timothy, indicating that alfalfa is a ravenous consumer of that substance.

ALFALFA REQUIRES CLEAN SOIL

While the mature plant shows such a sturdy growth and produces such a wonderful root system, still the young plant is exceedingly tender. Almost any weed will beat the young alfalfa plant in the race for existence, and smother and kill it. It is, therefore, of the utmost importance that the soil should be kept free from weeds. This may be accomplished in several ways: —

First. By raising some cultivated crop, preceding the sowing of alfalfa, and thus keeping the weeds thoroughly subdued during its cultivation.

Second. Seed the land to a crop of cowpeas, buckwheat, or some other densely growing crop, and follow with alfalfa.

Third. Plow the land several months before seeding, and during that period harrow or disk the land thoroughly at frequent intervals, thus destroying the weeds.

It is good practice to grow some crop which makes a very dense growth, such as oats and peas mixed, and which can be removed for hay or soiling crop by the middle of July; then disk the soil thoroughly and sow the alfalfa seed. By that time the early weeds will have been exterminated and the late weeds will not be likely to smother the young alfalfa plants.

PREPARING THE SEED BED

The tender nature of the young alfalfa plant requires that the soil shall be in the best possible tilth at the time of planting. It should be thoroughly pulverized, but fairly firm below the surface, so that the taproots will not encounter dry, coarse earth in their downward travel.

THE SEED

It is to be regretted that impure alfalfa seed offered for sale is the rule rather than the exception; this is true of other crops as well. The seeds of alfalfa and the clovers are generally costly, offering temptation to some dealers to adulterate them with various weed seeds, and seed growers are led to place upon the market seeds

from crops that should never have been harvested. There are, however, reliable and competent dealers from whom seed can be purchased, and in this connection the old adage applies with double force, "the best is always the cheapest."

THE TIME TO SOW ALFALFA

The locality must necessarily govern to some extent the time of seeding. The only general rule that can be laid down is to sow as far as possible in advance of what is likely to be the most trying season for the young plants. In the South and Southwest late summer seeding is practiced, because the rank growth of spring and summer weeds is thus avoided. In the Northern and the Eastern States, spring or early summer seeding is practiced by many, because the plants then have time to become strong and well developed before being called upon to withstand the severe frost and storms of winter.

It is doubtful if it is ever wise to sow a nurse crop with alfalfa, with possibly one exception: this being when the soil is sandy and so light that it blows about in the wind, with the probability of cutting off the young plants.

QUANTITY OF SEED PER ACRE

A pound of alfalfa seed contains about 220,000 grains, and there are 43,560 square feet in an acre. This would furnish about 5 seeds to the square foot, which is about the number of plants that will grow well upon a square foot of good alfalfa soil. In actual practice, however, no such result is obtained from seed. Much of it fails to germinate, a portion at least is weed seed, and many other unfavorable things befall the tender plants, so that it is



YOUNG ALFALFA PLANTS.

Showing nitrogen gathering nodules on roots.

By courtesy New York Agricultural Experiment Station, Geneva, N.Y.



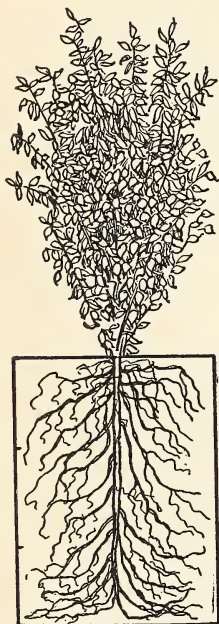
usually necessary to sow from 20 to 30 pounds per acre in order to secure a proper stand of plants. In the West, where the conditions are nearly ideal for alfalfa raising, a much smaller quantity may safely be used — sometimes as low as 5 pounds per acre.

INOCULATION FOR ALFALFA SOIL

As explained in preceding pages, the legumes, in order to properly develop, must contain within their root systems certain minute germs, bacteria, etc. These burrow into the roots and form tubercles through which nitrogen is introduced to the plant in the form of nitrates. In the humid parts of the country these germs do not usually exist except as they are introduced into the soil by some artificial means. Under such conditions it becomes necessary to provide them in the soil where legumes are to be grown; this practice is known as inoculation.

The usual method of inoculation for alfalfa is to obtain soil from some field where alfalfa has been growing for some years and spread it over the new field at the time of seeding for the new crop. From 200 to 400 pounds per acre of such soil is sufficient to inoculate the new field, if properly done. The soil so transferred should be sown as evenly as possible over the new field at or near evening, so as to escape the direct rays of the sun, as sunlight is generally destructive to germs. Early the next morning the land should be thoroughly harrowed, so as to mix the transferred soil with that of the new field. Or the whole process may be done on a dull day when the sun is overcast. If no old alfalfa soil is convenient,

and there is an accessible clump of sweet clover growing, it may be plowed and the soil from it transferred in the same manner. It should be noted that the germs which inoculate sweet clover are the same as those in alfalfa. If neither alfalfa nor sweet clover soil can be obtained, resort must be had to artificial cultures, which are supplied by the United States Department of Agriculture.



Everything is favorable for this alfalfa plant except that it should have a lower water table.

These cultures are furnished in hermetically sealed tubes, the contents of which are mixed with pure water, and certain chemicals are added to the solution which cause the germs to rapidly multiply, and the solution becomes slightly milky in color; it is then applied directly to the seed. The seed is then dried in a shady place and sown as soon as dry.

The advantage of this process of inoculation is that no weeds are added to the soil, as is likely to occur when soil is transferred from one field to another.

THE TIME TO CUT ALFALFA

Alfalfa should be cut when it is just beginning to blossom. At that time it is richest in feeding value. New shoots are beginning to start from the roots, and if the first crop is removed and the sunlight let in, these will soon bring forth a second crop.

GATHERING THE CROP

After the crop is cut it should be allowed to wilt, and before it becomes dry it should be raked and piled into rather small cocks. It should not be cured to the extent of being absolutely dry, but should be put into the barn or stack before the leaves begin to break off to any great extent. It should be remembered that the major part of the protein contained in alfalfa hay is stored in the leaves, and if the crop is allowed to dry upon the ground in the swath, most of the leaves will be lost in gathering the crop and its value greatly reduced.

THE FIRST CUTTING OF ALFALFA

The first cutting of alfalfa should not be nearer the ground than 4 inches, otherwise the new shoots will be cut off and the second crop thus injured.

FEEDING VALUE OF ALFALFA

The Arabs were wise in their generation when they pronounced alfalfa "the best fodder," and the results of our own experiments amply confirm their judgment. The following table, taken in part from Henry's "Feeds and Feeding," gives the digestible nutrients in alfalfa and other forage crops when fed to animals on the farm: —

DIGESTIBLE NUTRIENTS IN ALFALFA AND OTHER FORAGE CROPS

KIND OF FORAGE	DRY MAT- TER IN 100 POUNDS	DIGESTIBLE NUTRIENTS IN 100 POUNDS		
		Protein	Carbohy- drates	Ether extract
	Pounds	Pounds	Pounds	Pounds
Fresh alfalfa	28.2	3.9	12.7	0.5
Fresh clover	29.2	2.9	14.8	0.7
Alfalfa hay	91.6	11.0	39.6	1.2
Clover hay	84.7	6.8	35.8	1.7
Timothy hay	86.8	2.8	43.4	1.4
Cowpea hay	89.3	10.8	38.6	1.1
Wheat bran	88.1	12.2	39.2	2.7
Shelled corn	89.1	7.9	66.7	4.3

ACTUAL FEEDING VALUE OF DIFFERENT FEEDS BASED ON AMOUNT
OF DIGESTIBLE NUTRIENTS

FEED	VALUE PER TON	FEED	VALUE PER TON
Fresh alfalfa	\$ 7.00	Timothy hay	\$ 9.80
Fresh clover	5.96	Cowpea hay	19.76
Alfalfa hay	20.16	Wheat bran	22.80
Clover hay	14.12	Shelled corn	20.16

ACTUAL YIELD PER ACRE OF THE THREE MOST COMMON FORAGE
CROPS PER YEAR

Alfalfa (three cuttings)	5 tons per acre.
Clover (two cuttings)	3 tons per acre.
Timothy	2 tons per acre.

What does a study of the above tables teach? Simply this: that an acre of good alfalfa has a feeding value of \$100.00 per acre, while an acre of clover has \$42.36 per acre, and an acre of timothy has a feeding value of only \$19.60 per acre. And also that a ton of alfalfa is nearly as valuable as a ton of wheat bran.

CHAPTER XII

CLOVERS

SWEET clover and burr clover are in some respects allied to alfalfa, having a slight similarity of appearance, and the same bacterial germs furnish the inoculation for all alike.

Sweet clover and burr clover are not generally treated as farm crops; they are considered simply as weeds, and need no further discussion here. The principal clover crops will be treated in the order of their importance:—

RED CLOVER

Red clover is adapted to a wide variety of soils and climates, and hence is more generally grown as a forage crop than any other legume. It is rich in protein and nitrogen free extract, and furnishes a large amount of dry matter. It is nutritious, palatable, and valuable as a feeding substance, because it contains the elements of a good feeding ration. It occupies an important place in crop rotation and also as a green manure and cover crop. It is biennial and, like most of the other clovers, shows best results when grown on deep, rich loam that is well drained, so as to escape the “heaving” incident to winter frosts.

Clay soils, when properly fitted, produce excellent crops

of red clover, as also do light, sandy soils if sufficiently fertilized.

PREPARING THE SOIL

The preparation of the soil for red clover is practically the same as for alfalfa. Lime in considerable quantities must be supplied either naturally or artificially, and the mineral plant foods must also be present in sufficient quantities, especially potassium and potash.

It has of late become popular with many writers upon the subject of legumes to urge that clover, being a legume, and consequently a nitrogen-gatherer, is not benefited by the addition of nitrogenous manures. It is further claimed by some that the presence of large quantities of vegetable matter in the soil actually prevents the development of the bacteria necessary for the best growth of the crop. In practice, however, this theory is not borne out, for every successful farmer knows that the richer his land, the better the clover crop. Indeed, we may go farther and say that generally the most abundant returns from the application of barnyard manure are those derived from the application of liberal quantities as a top-dressing to clover.

SEEDING

From 8 to 12 pounds of seed should be sown per acre if the seed is of good quality and the soil is in proper condition; but if the soil is weak or the seed is inferior, the quantity should be increased. The seed may be sown broadcast in March or April on land seeded the previous fall to wheat or rye; or, it may be seeded in the spring with oats or barley, which is the usual prac-

tice in cool and moist climates. Lately the practice of seeding red clover without a nurse crop, in August or September, has met with good success where the soil was in good condition to allow the plants to make a strong growth and become well rooted before winter. Such a crop will usually be ready to harvest as soon as the crop sown in the old way, and permits of securing some other crop from the same land during the early part of the preceding season.

AS A SOILING CROP

As a soiling crop, red clover should supply from 8 to 12 tons per acre, and should last at least two weeks from the time when the heads are fully formed. The second cutting should yield from 5 to 6 tons per acre, ready to feed in August.

RED CLOVER AS HAY

Next to alfalfa, red clover is one of the most valuable forage crops for dairy feeding. Indeed, almost every farm animal is benefited by the feeding of red clover, whether cows, sheep, young stock, swine, or poultry. It is doubtful if its merits in this respect are half appreciated as a farm crop. It is valuable as hay, as a soiling crop, and as a green manure crop; its roots render the soil open and porous and richer in nitrogen.

CURING THE HAY

Clover should be cut when free from moisture and raked into windrows as soon as wilted, then allowed to cure in cocks. It should be remembered that the chief value of clover, like alfalfa, is contained in the leaves,

and if the crop is allowed to dry in the swath, most of the leaves will break off in handling, and much of the value be lost.

Rains and dews are injurious to the crop while curing, quickly changing the color of the leaves to a dark brown, and soon destroying the rich aroma from the essential oils which make clover so palatable and attractive, and which have so often furnished a theme for the poet's fancy.

Red clover furnishes excellent pasture for stock of all kinds; but it is not wise practice, because the result is usually the destruction of the plants and consequent curtailment of subsequent cuttings.

MAMMOTH CLOVER

Many farmers do not favor mammoth clover because its large, coarse stems are not readily eaten by stock when fed in the form of dry fodder; but for many purposes it is unsurpassed in usefulness as a farm crop. It makes a splendid soiling crop, good ensilage, and is one of the most valuable of crops in renovating the soil and preparing it for subsequent crops. Its deep-running roots are able to penetrate the subsoil to remarkable depths, leaving the soil in the open, porous condition so necessary for the best development of plant life. The decay of its strong roots adds large quantities of humus to the soil, while as a green manure crop, when plowed under at the proper time, it has no equal.

This crop, like all of the legumes, thrives best on rich, well-drained soil that is well supplied with lime.

WHEN TO SEED

The seed should be sown in the late summer or fall at the rate of 12 to 15 pounds per acre without a nurse crop, and it may be cut the first time in the following June when in full blossom. The plant is perennial, and yields from 8 to 12 tons per acre during the season as a soiling crop.

ALSIKE CLOVER

Alsike clover is perennial, and in many respects differs materially from the other members of the family. It generally survives the hardest winters. It will thrive well on soils that are too wet for other clovers, and produces good crops 5 or 6 years in succession. It is a shallow-rooted plant as compared with other clovers, and should always be seeded with a nurse crop. It is usually advisable to seed with this clover a liberal quantity of timothy, thus avoiding as far as possible the tendency to lodge. If the seeding is done in the summer or fall, it is wise to seed with wheat or rye, as with red clover. Sow at the rate of 6 to 8 pounds to the acre.

THE USE OF ALSIKE CLOVER

Alsike clover makes a fine-stemmed and very palatable hay, and is also very valuable as a soiling crop. It is prolific in leaf development and should, therefore, be handled with great care to avoid breaking and loss of the leaves, which are rich in protein and give the plant its high feeding value. In common with other clovers it makes excellent pasture, but is very liable to injury by the tramping of stock, especially if grown upon moist soil.

CRIMSON CLOVER

Crimson clover differs in many respects from the other clovers. In some of its features it is deemed more desirable, and in others less, as a farm crop. First of all, it is an annual, and hence requires reseeding every year as long as the crop is grown. Second, it does not thrive in hot weather; hence, must be harvested in the spring, when there is usually very little suitable weather for the purpose. On the other hand, it is essentially a cool-weather plant, thrives best in late fall or early spring, maturing as early as June 1st. It will readily be seen that it is well adapted for a catch crop or clover crop, without interfering with regular rotation crops. While it is, as said, essentially a cool-weather crop, it is not a cold-climate crop, and but little success has been reported with it north of the southern or middle portions of New York State. Wherever it can be successfully grown, it has proved to be the most valuable in many respects of the clover family. As a green forage crop, it has become very valuable because of its habit of early development and maturity. May 15 finds crimson clover ready to take its place in the rotation of soiling crops, and by June 1st it is ready for hay. In this form its percentage of feeding value compares favorably with any other clover.

SEEDING

Crimson clover should always be seeded in the fall, as it refuses to grow in hot weather. From 12 to 15 pounds of seed should be sown per acre on mellow, well-tilled, rich soil, and lightly harrowed in.

Crimson clover is used to good advantage as a catch crop seeded in corn at the last regular cultivation. It will make a good growth after the corn is harvested and until late in the fall, and will benefit the soil very materially if plowed under in the spring in time to plant the regular crop.

SOIL FERTILITY

The theory advanced by some writers to the effect that crimson clover will thrive on poor soil where little else will grow, is wholly erroneous. It not only requires a rich soil that is well supplied with humus, but one equally well supplied with mineral foods and an abundance of lime. A little reflection upon the habits of the plant will convince any one that this must be true. Its period of growth in both fall and spring is very short, being confined to the brief seasons when other plants grow but little. Under such conditions the plant cannot possibly develop unless the soil is rich and in the best possible condition to insure such development.

As a forage plant, crimson clover is a cheap one to raise. The seed is usually low in price, and as it is commonly grown as a catch crop and in no way interferes with the crops in regular rotation, it serves a very necessary and useful purpose. It affords excellent pasturage both late in the fall and early in the spring, when good pasture is most appreciated.

WHITE CLOVER

It is unnecessary to discuss the subject of white clover except for pasturage purposes. It is neither suitable nor profitable as a forage crop, but when properly seeded

with other grasses it makes ideal pasture for all kinds of stock. Its habits of growth are such that it does not stand erect, but creeps along the surface of the ground and divides and subdivides its branches until large areas are covered. The close proximity of its roots to the surface of the ground enables it to withstand climatic changes and extremes, and also to maintain itself on soil that would not be strong enough for other clovers.

It should be seeded in the spring, with or without a nurse crop, and with other grasses, at the rate of 10 pounds per acre, upon soil naturally slightly moist. A top-dressing of wood ashes seems to be the ideal treatment for a pasture of white clover. If a good catch of the seed is secured, it will furnish the finest possible pasturage for 5 to 6 years.

It cannot be too strongly impressed upon the mind that all clovers require large quantities of lime in the soil; if this is not naturally present, it must be supplied artificially if the best results are to be obtained.

CHAPTER XIII

OTHER LEGUMES

THE cowpea has become a valuable crop in many sections of the United States for use as a soiling ration, dry forage, and as a green manure crop. While it is best adapted to the warmer climate of the South, several of its varieties have been developed which thrive well in many of the Northern States.

VARIETIES

There are more varieties of cowpeas than of clovers, and the variations in their habits, form, and adaptability are most remarkable. Varieties cultivated in the Southern States known as "trailers" sometimes run along the ground to a distance of from 10 to 15 feet, while other varieties stand upright, and may reach a foot or two in height. Some varieties have pods 2 or 3 inches long, while others bear pods a foot long or even more. Some varieties develop in 60 days, while others require 6 months. Any of these varieties will grow and mature in the Southern States, but only the short, upright ones should be attempted in the brief growing seasons of the more northerly States. For the purpose of a soiling crop or hay, the best varieties to cultivate are Red Ripper, Whippoorwill, Wonderful, Clay, and New Era. These varieties are, moreover, very valuable as soil renovators and green manure crops.

SEEDING

The seed should be sown at the rate of about one bushel per acre as soon as the soil becomes thoroughly warm in the spring and all danger from frost is passed. It may be broadcasted or sown in drills and cultivated like corn, in which case less than half the above-named quantity of seed would be required. The depth to which the seed should be covered will depend somewhat upon the soil and season. On heavy soil and in a damp season, one inch will be sufficient, but for a light soil and a dry season, two or three inches may be proper.

FERTILIZERS

Like other legumes, the cowpea thrives best on a good, rich, well-prepared seed bed, and also requires plenty of phosphoric acid and potash. A good mixture to apply would be 300 pounds of acid phosphate and 100 pounds of muriate of potash.

YIELD

The yield per acre is practically the same in tons as of good clover, but its feeding value is very high because of the large percentage of protein it carries. It is relished exceedingly by stock, and when properly grown, handled, and fed, should materially reduce the quantity of the grain ration.

SOY BEANS

The soy bean resembles the cowpea in many respects, and the same course should be largely followed in its cultivation. It is in no way superior in value as a green manure crop, a soiling crop, or for hay, and presents

some difficulties not encountered with cowpeas. It is, however, an important crop in various localities where cowpeas cannot be successfully cultivated. It always grows erect, and its large, spreading leaves are supported on large woody stalks which are of little use for fodder.

THE PEA AND ITS USE

The pea is an important member of the family of legumes, and its use is general in certain sections as a field crop for the production of grain for stock feeding, for split peas for table use, for green peas for canning, for forage crops, soiling crops, and ensilage. It is doubtful if it has a superior as a soiling crop for dairy cows, and the grain is hardly excelled by that of any other plant as a ration for all kinds of farm animals.

SOIL AND CLIMATE

Peas thrive best in a cool, moist climate like that of southern Canada and the northern part of the United States. The Province of Ontario, Canada, has a climate and soil peculiarly fitted to the requirements of the plant, and the Canadian pea has acquired a wide and well-deserved renown. In the United States, New York, Michigan, Wisconsin, Montana, and Washington have each become more or less prominent as pea-growing States, and the use of the crop for various purposes is rapidly increasing.

VARIETIES

The two principal classes into which popular usage has divided peas are the field pea and the sweet pea. The field pea is usually grown for grain, soiling crop, forage,

and green manure crop, while the sweet pea is principally used for canning and as a fresh garden vegetable for table purposes. The field pea comprises such varieties as the Prussian Blue, Canadian Beauty, Tall White Marrowfat, Early Britain, and Golden Vine, while the Gregory Surprise, Alaska, Advancer, Horsford, Telephone, Abundance, Champion, and Everlasting are among the more common of the sweet peas.

THE SOIL

Peas thrive best on clay loam. Sandy soils are generally too dry, and muck soils too rich, causing a rank growth of vines, and seldom producing seeds.

SEEDING

Field peas on ordinary soils should be seeded at the rate of two bushels per acre, and sweet peas at three bushels per acre. The seed should be covered rather deeply (two inches or more), and the crop may be sown as soon as it is possible to work the land in the spring, or at any time from then until June.

PREPARATION OF THE SOIL

The soil should be prepared substantially the same as for other leguminous crops, and the same care should be exercised in making a good seed bed.

BENEFIT TO THE SOIL

It is difficult to estimate the benefit to the soil derived from a good crop of peas. In addition to the nitrogen brought to the soil is the further advantage that the land

is made mellow, open, and porous, and also that peas will usually exterminate every weed in the field.

TIME IN WHICH TO MATURE

Depending upon the variety, the crop will usually mature in from 50 to 80 days from seeding.

BEANS

"The land won't raise white beans" is a common and very forcible expression which is often used to describe poor land. Perhaps by the common use of this expression the belief is general that beans will thrive on poor soil; this is very far from the truth. It is a fact that beans require less fertility than potatoes or corn, but at the same time it will be found that "good soil produces good beans."

Like most leguminous crops, beans develop best on limestone soils, or upon soils otherwise supplied with lime, and the soil best adapted to the crop is clay loam, well supplied with humus and well drained.

VARIETIES

Some half a dozen varieties of commercial beans are grown, including the marrow pea bean, the Boston bean, medium bean, white marrow, red marrow, white and red kidney, and the black turtle soup bean. These varieties are distinct from those grown for garden and canning factory purposes, and are known as field beans. There are several varieties grown for table use in the green state and for canning, but the principal one is the broad bean.

CLIMATE SUITABLE FOR BEANS

In respect to climatic conditions the requirements of beans and peas are substantially identical, and both thrive best in cool, moist regions such as the northern and eastern parts of the United States and the southern part of Canada.

SEEDING

The quantity of seed to be used will be determined by the variety planted. Many growers sow from one half to a bushel per acre of the small varieties such as the marrow and the Boston beans, and six pecks of the kidney varieties, varying the quantity according to size.

THE SEED BED

Beans may be successfully grown on inverted sod land, but in that case the land should be plowed in the fall or as early in the spring as possible, so that the sod may have time to decay before the planting. In either case it is good practice to harrow the land several times at intervals before planting the seed. If the soil is poor, the land should be treated with a dressing of barnyard manure or generous applications of phosphoric acid.

TIME TO PLANT

In New York and the Eastern States the time to plant ranges from May 15 to June 15, depending on the variety used. The kidney beans are usually planted first, the marrows second, and the pea and medium varieties last. The point to be kept in mind is that the first named require a longer time in which to mature, hence earlier

planting is necessary; but beans should never be planted until the soil is warm and in good condition.

HARVESTING

Formerly it was a laborious and expensive task to harvest a large crop of beans, as the plants were pulled by hand and hung upon poles to dry. The crop is now generally harvested by the use of machinery, called the "bean harvester"; this is a two-wheeled machine provided with long, obliquely set blades which cut off the plants at the surface of the ground, two rows at a time, leaving it in the form of a windrow as the machine proceeds. This windrow is turned over when dry on top, and when the whole is dry it is raked with a horse rake and drawn to the barn. Special machines are used to thrash beans so as to avoid splitting of the seed as far as possible; but many farmers still prefer the flail, and no doubt are compensated to some extent for their labor by avoiding splitting of the beans. When the crop is finally thrashed and cleaned as perfectly as possible with machinery, there are still present the discolored and diseased beans, with more or less gravel and other foreign substances. All of these must be removed so that only perfect beans shall remain. Up to the present time the only practical method for this work is "hand picking." The dealer who buys the crop is usually equipped with machinery which facilitates the work by passing the beans slowly and evenly on a canvas apron before the "picker," who is thus enabled to see every imperfect bean or piece of gravel and throw it out.

DISEASES

In many localities where the bean crop was profitable and therefore largely grown in former years, its cultivation has been wholly discontinued because of diseases which attack the plants and render its cultivation unprofitable. The principal injury is caused by the disease known as "bean anthracnose," which is a result of planting diseased seed. It may strike the plants while they are young, or may wait the development of pods, which it then attacks and causes their destruction.

TREATMENT OF PLANTS

While it is not probable that this disease can be entirely prevented or cured by treating the plants, yet the following will be found very beneficial: when the plants are putting forth the third leaf, spray them thoroughly with a Bordeaux mixture composed of 6 pounds of vitriol, 4 pounds of lime, and 2 pounds of resin soap, all dissolved in 50 gallons of water.

USES OF THE CROP

Besides the commercial value of the bean, which always brings a high price in market, the straw is valuable as roughage for stock, and the by-product or picked refuse makes good food for many farm animals, especially swine and sheep. The crop can be grown in rotation between two grain crops, or between grain and corn or potatoes. It loosens the soil, kills the weeds, adds nitrogen to the land, makes a good green manure crop, and altogether is a good crop to raise.

THE VETCHES

In some localities and under certain soil conditions the spring and winter vetches seem to be desirable as forage crops, yet both seem to have serious defects under some circumstances.

The spring vetch makes a good soiling crop when sown with oats in localities where peas do not thrive, but the crop is in no way superior to a crop of oats and peas, and is liable to degenerate into a troublesome weed, sometimes so infesting the land as to make the growing of wheat unprofitable in many localities.

To secure a forage crop, the winter vetch may be sown with wheat in August or September at the rate of about one bushel of each per acre, on rich, well-tilled soil, so that a substantial growth may be secured before winter sets in. It will mature with the wheat in the spring, and a large forage crop will result.

Complaints are frequently heard regarding the effects upon stock fed upon winter or hairy vetch. It is claimed that the hairy covering of parts of the plant, when eaten by animals, fail to digest, and form into balls which obstruct the digestive processes to such an extent as to cause the death of the animals. It has the advantage, however, of being an early spring crop, and is rich in feeding qualities.

UNIMPORTANT LEGUMES

Among these may be mentioned the velvet bean, the horse bean, and Japan clover, all of which have their value in their proper place, but are not important for consideration in a work of this character. None of them

are native to the United States, neither have they become sufficiently acclimated to be successfully grown except in limited areas. Generally speaking, it is not the part of wisdom to introduce these plants upon the farm except to serve some special purpose.

CHAPTER XIV

CORN AND HOW TO GROW IT

THE SOIL

IN common with every other crop, the first question to be considered under this heading is the soil. The ideal condition of soil for corn is a sandy loam, rich in humus, well drained, with a gravel subsoil which maintains a constant supply of moisture and still presents a low, permanent water table. The best results are obtained by the application of 10 to 15 tons of fresh barnyard manure to old meadow, growing clover or alfalfa, and plowing it under the previous fall, thus giving the vegetable matter an opportunity to decay before the plant roots reach it in the following season.

The soil should be thoroughly harrowed or disked as early in the spring as it is possible to get upon the land without injury to the soil, and the field put in the best possible condition. If barnyard manure is not available, a good crop of clover, alfalfa, or peas should be plowed under and the same treatment given.

THE TIME TO PLANT

In the Eastern and Northern States it is generally advisable to plant the seed as early as the soil can be put in proper condition, for the reason that the growing

season between early and late frosts is short, and a full season is generally necessary to bring the crop to maturity.

There is, of course, some danger of injury from late spring frosts, but, on the other hand, there is much greater danger from early fall frosts. Early spring planting has the additional advantage of securing a vigorous early start before weeds have a chance to interfere, and when the moisture in the soil causes quick germination and rapid growth.

There is a condition in the early springtime, a vague, unnamed something felt in the air, in the soil, everywhere, that seems to compel life, growth, and action. It is the time of the spring awakening; when the air seems to throb and the earth to respond with a silent yet perceptible and plainly felt movement — the result of countless millions of awakening, growing forms of life. We hear the hum of that wonderful workshop, but cannot locate it; neither can we define it. It is the time when the new year of nature is born. Fortunate is the farmer whose crop of corn is in the ground and ready to receive its share of the compelling forces which nature is providing for every living thing with lavish hand.

Experience has demonstrated that two weeks of growth in the early springtime under the conditions described is more valuable than four weeks at any other time of the growing season.

THE SEED

Such varieties of corn should be used as are best adapted to the climate and soil — the quick-maturing varieties where the season is short and there is danger from early fall frosts, and the slower-maturing varieties where the

seasons are longer. It is always important that a mature crop shall be secured, regardless of the purpose for which it is to be used. Before ears can be developed there must be a large, vigorous growth of stalks, strong in structure, and maintaining an abundance of foliage of the deepest green color.

The first requisite for securing a good crop of corn is good seed. Many failures are attributed to unfavorable weather and other causes which are in reality the result of poor seed. The ideal way to secure seed corn is to go through a field of ripe corn and select perfect ears from large, perfect stalks. This process of selection will, in a few years, result in establishing a superior variety of corn, perfectly suited to the locality, and producing at least double the ordinary crop. If, however, the seed is to be purchased from year to year, then it becomes important to test it before planting in order to determine what proportion of the kernels will germinate and the strength of the germination.

HOW TO TEST SEED

A small box one foot square and four inches deep, containing two inches of moist earth or sawdust, may be placed near a stove in a room where the temperature is maintained at about 70° F. A handful of corn is taken at random from the package of the proposed seed from which 100 kernels are counted and scattered evenly on the contents of the box. Cover the whole with a piece of Canton flannel so cut as to fit closely over the seed and soil. Moisten the cloth slightly by sprinkling warm water over it. In the course of 4 or 5 days, if the

seed is strong, small white shoots will appear at the smaller end of the kernels. If 95 of the kernels do not show good, strong shoots, look elsewhere for seed corn.

PLANTING THE SEED

When the soil is thoroughly prepared for the seed, the method of planting is the next subject for consideration. Extended experience has proved beyond a doubt that check-rowing corn produces the best results in the majority of cases. That is, the hills should be so spaced as to be a given distance apart in each direction, both lengthwise and crosswise of the rows.

ADVANTAGES OF CHECK-ROWING

This method of planting permits of cultivation both ways, — lengthwise and crosswise of the field, — insuring thorough cultural methods, permits the use of horse labor almost exclusively, rendering it impossible for weeds to grow. It also allows more air and sunlight to enter among the plants, which is a necessary factor in their proper development. This additional air and sunlight also act as a preventive, to some extent at least, of diseases that are more or less common to the crop. More important, however, is the fact that the ears and grain are materially improved by the check-row method of planting.

DEPTH OF PLANTING

On heavy clay soils the seed should be covered to the depth of 1 inch; on light, sandy soils, from 2 to 4 inches, the purpose being to secure sufficient moisture to quickly germinate the seed.

NUMBER OF KERNELS TO THE HILL

If the seed has been properly selected, cured, and stored, or if it has been tested and found good, 3 kernels to the hill will usually be found the proper number, provided the rows are 3 feet or more apart. A larger number will prevent proper earing, and in no way add to the value of the crop.

It should always be borne in mind that the ears and grain are the most valuable parts of the crop, whether grown for market or as ensilage for fodder. If intended for a grain crop, it is the number of bushels per acre that count. If for ensilage, the more mature grain there is mixed in the silo, the more valuable the ensilage becomes for fodder.

USE OF MACHINERY IN PLANTING

Various machines for planting corn and other seeds are to be found on the market that are so far improved as to do satisfactory work in check-rowing corn. The depth, the distance between the hills, and the number of kernels to the hill, can be regulated better even than by hand work, and they have the additional advantage of being able to distribute commercial fertilizers evenly and in such quantities as may be desired and without additional labor. One man and a good team can easily plant 8 acres per day with such a machine and do it well.

USE OF COMMERCIAL FERTILIZERS

Many corn growers believe that the use of certain forms of commercial plant foods are desirable when applied at the time of planting the corn crop, regardless of

the natural fertility of the soil, with the result that a variety of soluble, immediately available chemical foods are thus supplied for the use of the young plants, giving them a quick and vigorous start and rendering the root system better able to take hold of the natural elements found in the soil.

Corn is a large consumer of nitrogen and requires liberal quantities of both the soluble form for immediate use, and of the insoluble, or more slowly available, form for use in the later stages of development. If the seed is to be planted upon fertile soil that is rich in humus, it will generally be found profitable, when planting, to use a mixture consisting of the following: —

Nitrate of soda	. . . . .	500 pounds
Ground bone	. . . . .	200 pounds
Acid phosphate	. . . . .	200 pounds
Muriate of potash	. . . . .	100 pounds

Apply it at the rate of 150 to 200 pounds per acre.

It is proper to state in this connection that the more fertile the soil, the more profitable will be the result of applying commercial fertilizer, and the poorer the soil, the less profitable. In fact, many soils are too poor to profitably grow corn and should never be used for that purpose.

CULTIVATION OF CORN

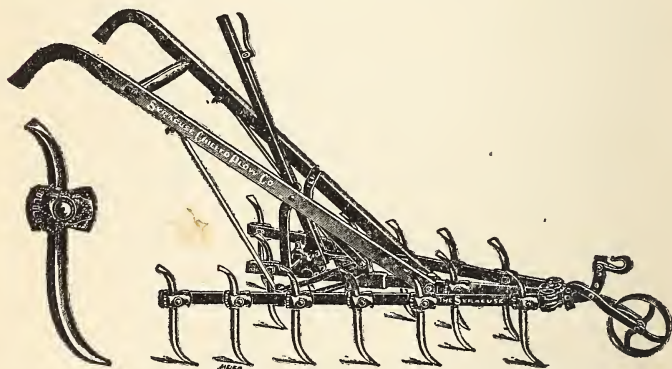
When the plants are up 3 or 4 inches, the whole field should be harrowed with a light, spike-tooth smoothing harrow, preferably following a heavy rain and as soon as the soil is fit. This treatment will have the twofold effect of destroying young weeds and of breaking up the

crust which always forms upon the surface after a rain. A crust should never be allowed to form on the surface of the soil, for it supplies the best possible means for the escape of soil moisture, and if allowed to continue, will rob the plants of the moisture in a very few days.

The most effective means of preventing evaporation from the soil is a blanket laid close upon the soil surface. Proper cultivation will form such a blanket, which is called "mulch." This is simply maintaining a fine, shallow blanket of soil on the surface, which has the effect of breaking up the capillary action and checking evaporation.

CULTIVATORS

Several different forms of machines are successfully used in the cultivation of corn, from the one-horse walk-



A good mulch maker.

ing cultivator, to the 2, 3, 4, and 5 horse riding machines. The profitable use of any of these machines must be

determined by the topography of the land and the condition of the soil. As a rule, the larger the machine handled by one man, the more profitable will be its use.

FREQUENCY OF CULTIVATION

There is a general rule which may be laid down regarding when to cultivate corn, to wit: cultivate with sufficient frequency to destroy all weeds, and cultivate as soon as possible after every rain.

DEPTH OF CULTIVATION

Excepting the first cultivation, deep cultivation is injurious to the crop. The first cultivation may properly go as deep as the cultivator will do good work and not cover the plants, but subsequent cultivations should not exceed 3 inches in depth. Lateral roots must be protected, and a deeper cultivation will cut off many of them.

SOIL WASHING

Heavy rains frequently do considerable injury in washing out the plant foods and fine particles in the soil, which are carried down to creeks in the form of muddy water. Soil washing may be largely prevented by planting the rows at right angles to the slope of the ground, or by keeping the rows on a level and letting them follow the curve of the hill. Straight rows are best on level land, but curved rows are better practice on a hillside.

YIELD OF CORN

The average yield of corn per acre for the whole United States is 25 bushels. By the adoption of improved

methods of cultivation, proper seed selection, and improvement in soil fertility, many farmers are producing 75, 100, and some of them 125 bushels per acre.

It is apparent that if farmers generally would adopt more rational methods, the yield from our corn crop could be easily doubled without increasing the acreage.

CHAPTER XV

THE CEREALS

BARLEY

BARLEY is an annual cereal grain which is supposed to be a native of Asia. In earlier times it was used extensively for human food throughout the civilized countries of Europe, Asia, and Africa. Other cereals that are better adapted to bread making have gradually taken its place in this respect until now it is mostly consumed for brewing purposes and stock feeding. The value of the barley crop produced in the United States each year is about \$50,000,000.

VARIETIES

As used by seedmen and farmers, the principal varieties may be described as the four-rowed, the two-rowed, and the beardless barley.

ADAPTABILITY

No other cereal is grown under so wide a range of climate and soil conditions, and none so readily adjust themselves to new conditions and natural environment. In Europe barley is cultivated from the Mediterranean to Lapland, and in America from Mexico to Alaska.

THE SOIL

The soil for barley should be fall plowed and thoroughly disked in the spring as early as it can be worked to advantage. All lumps and clods should be broken down

with the roller and harrow and a mellow seed bed provided. The crop is quick-growing and matures early. The soil should be well provided with plant food in available form.

The best results are obtained when the soil is fully supplied with well-rotted barnyard manure and free from a superabundance of moisture. If there is a lack of fertility, the soil should be treated with a mixture of 120 pounds of nitrate of soda, 200 pounds of acid phosphate, and 30 pounds of muriate of potash per acre. A rich clay loam is the ideal soil for barley.

SEED

The seed should be sown as early in the spring as the soil can be put in good condition, usually the latter part of April or first of May, and at the rate of about two bushels per acre. If the crop is sown in connection with a seeding of clovers or grasses, and is to be regarded as a nurse crop, then one bushel per acre will usually be sufficient. As a general rule, the richer the soil, the less seed need be used.

ROTATION

Barley is one of the most valuable of crops in farm rotation, as it naturally follows corn, potatoes, or other root crops, and since it is a very successful nurse crop, it is naturally followed by alfalfa or some one of the clovers.

DISEASES OF BARLEY

"Barley smut" is the disease most injurious to the crop and causes more or less loss each year, especially in localities where it is frequently grown in the same field.

The smut is a fungus disease which is caused by minute spores lodging beneath the hull in the grain. When these spores are ripe, they are carried about the field by the wind and lodge in the hulls of healthy kernels. The hulls then close over the spores and the disease germs are again planted for further destruction.

TREATMENT OF SEED

Into a barrel containing 20 gallons of water pour a pint of formalin. Place a sack of barley seed in the solution and let it soak ten minutes, then remove it and spread it out on a floor or platform to dry, keeping it covered for two or three hours with blankets so that the fumes of the formalin may better act on the spores. If this treatment is well performed, it will usually insure the crop against injury from smut.

USES OF THE GRAIN

If barley is cut in the milk stage and is well cured, it makes very rich and palatable hay for stock. The grain, however, is commonly allowed to ripen and is disposed of for brewing purposes and the by-product used for stock feeding in the form of brewers' grains, malt sprouts, etc.

Barley meal is one of the best stock foods when used in combination with other by-products, and is valuable for cows, horses, swine, and poultry.

OATS

Unlike barley, oats are usually successfully grown only in the north temperate zone, including such parts of

Russia, Norway, Sweden, Germany, and the north-central part of the United States and Canada as lie within an irregular belt around the earth. This area supplies the major part of the world's oat crop. The oat crop of the United States is valued approximately at \$300,000,000 per year, and the average yield per acre is 34 bushels. Eleven States produce four fifths of the entire crop of the United States. These States, in the order of production, are as follows: Iowa, Illinois, Wisconsin, Minnesota, Nebraska, Indiana, New York, North Dakota, Pennsylvania, Ohio, and Michigan.

VARIETIES

There are more than seven distinct varieties of oats representing various forms of kernel, from the long, slender kernel to the short, plump, and nearly round form. These varieties also show various colors, including white, yellow, red, gray, and black.

The two principal varieties which constitute the major portion of the crop as at present cultivated are the spreading variety in which the branches spread out in all directions from the rachis; and the side or mane oats in which the branches all hang from one side, giving them the appearance of a mane.

ADAPTABILITY AND SEED

It is only necessary to say under this head that certain varieties will excel in some parts of the country better than others. Those varieties should be selected for seed to which the conditions, surroundings, and soil are most congenial. In other words, seed from oats producing a

remarkable yield in Wisconsin may utterly fail in producing even an ordinary crop in New York; but seed from a successful crop in New York will, if properly cultivated, be reasonably certain to produce a good crop in the same State.

As with every other crop, only the best possible seed should be sown, heavy in weight, plump, full of kernel, and free from all weed seed and fungus growths.

The best possible treatment for seed oats is to run them through a fanning mill, using sufficient force to blow out everything except the very heavy and plump seeds. The lighter grains need not be lost, because they can be used to advantage for stock feeding. The seed should then be tested to determine its germinating qualities, following the same course as described in testing corn. In order to prevent as far as possible the disease of oat smut, the grain should be treated with a 4 per cent solution of formalin, as described for barley.

HOW TO TEST THE SEED

As the wise farmer should wish to test the seed of almost every farm crop before placing it in the ground, the simplest method of doing so with small seeds is as follows: Take two dinner plates and a piece of Canton flannel about a foot wide and two feet long. Wet the flannel in warm water and run it through a wringer. Place half of the cloth over the first plate and put upon it 100 seeds to be tested. Cover the seeds with the other half of the cloth, pressing it down evenly over them. Place the second plate upside down over the whole, and set them where the temperature will remain at 75 or 80

degrees for three or four days. Keep the top cloth moist by sprinkling it with warm water occasionally. At the end of this period the good seeds will have sent out shoots, making it possible to determine the percentage of fertile seeds and also the strength of germination. If 95 per cent of the seeds do not germinate, discard the seed.

PREPARATION OF THE SOIL

The vital point in oat culture is to "sow early." Oats require a cool climate and abundance of moisture, and these are best secured by sowing the crop at the earliest possible time that it can be done without injuring the soil. By "abundance of moisture" is not meant wet land, which is fatal to oats, but such treatment of the soil as will best conserve the natural moisture in the ground and prevent as far as possible a loss of it by evaporation. The top soil should be disked and harrowed thoroughly from the time it is sufficiently dry in the spring (after fall plowing) until the crop is planted.

If the land is sour, it will be wise to apply 2000 pounds of lime per acre, and if the previous crop was not well manured, it may be necessary to apply a mixture consisting of 120 pounds of nitrate of soda, 200 pounds of acid phosphate, and 30 pounds of muriate of potash per acre. Both the lime and the fertilizers should be thoroughly incorporated with the soil before the seed is sown.

TREATMENT OF THE CROP

When the plants are about four inches high, the field should be gone over once with a light, spike-tooth smoothing harrow. This will break up any crust which may

have formed on the surface, and aid materially in preventing evaporation and loss of moisture, and preserve it for the use of the crop.

It is suggested that any farmer who has not tried the experiment of harrowing his oat crop, as just described, should treat one half of his field in that way, leave the other half untreated, and observe the result.

QUANTITY OF SEED

Most farmers sow too much seed. If the soil is fertile and properly tilled, more and better grain will be secured from a seeding of one bushel per acre than from three bushels. Of course much depends upon the condition of the soil and something also upon the season; but the plant stools profusely, and heavy seeding is more likely to result in injury than in benefit. One inch will usually be found a sufficient depth to plant the seed.

AS A NURSE CROP

Oats are considered one of the best nurse crops for the seeding of legumes or grass, and if there is no unusual amount of fertility in the soil, causing the oat crop to lodge, the seeding will generally be successful.

AS A SOILING CROP

Oats as a green crop, or sown with Canadian peas, make one of the most satisfactory soiling crops for dairy cows. They should be fed just when the seeds are forming, or, to use a common expression, just when they are "in the milk." They are very palatable and always a milk producer.

OATS AS FOOD

Regardless of results obtained by analysis of oats and their value as feeding stuff as determined by their content of digestible nutrients, every farmer of experience knows that as food for horses no other grain compares with oats, while as a milk producer in the dairy they have no superior. As human food the use and popularity of oats is increasing daily, and in Scotland, where their consumption as food has been constant for hundreds of years, it is said to produce both the largest men and the largest horses.

WHEAT

What has been said regarding oats and barley in respect of thorough preparation of the soil, liming, fertilizing, cultivation, selection of seed, testing seed, and planting, applies with equal force to wheat.

VARIETIES

Like oats, we find many varieties of wheat differing in shape and color of berry and contrasting strongly in the general appearance of the mature plant, from the bald or beardless club wheat to the long-bearded durum. For all practical purposes wheat is divided into two great classes, viz. winter and spring wheat.

WINTER WHEAT

There is little doubt that winter wheat is a result of artificial breeding, aided by environment, and so successful have been the results obtained that the plant is now able to withstand the winters of many of the most severe

and northerly climates, and continue its development in the following spring, ripening one or two months earlier than its brother, the spring wheat, in the same locality and soil.

WHEN TO SOW

There can be no definite date fixed as the proper time to sow winter wheat, as the matter must be decided according to the conditions affecting the particular locality. Generally it is wise to sow the seed so as to enable the plants to make a fair growth before frost, and thus be better able to withstand the winter.

THE SEED

There is probably no crop grown that is more directly affected for good or ill by the condition of the seed than wheat. The crop grown from well-selected, good seed is certain to show a material increase over that grown from inferior seed, this increase frequently amounting to as much as 100 per cent.

DISEASES OF WHEAT

The same treatment should be given seed wheat as has been recommended for barley and oats to guard the crop from the disease of burnt smut; but there are other forms of smut which attack wheat which do not yield to this treatment and for which it is doubtful if a sure remedy has been discovered.

ENEMIES

The chinch-bug and the Hessian fly are the worst insect enemies of wheat, and losses of millions of dollars annually

result from the ravages of these two pests. No satisfactory remedy has been discovered for either.

Wheat is the most largely used article of human food in civilized countries, and the United States leads all countries in its production.

RYE

While rye occupies a much less prominent place as a farm crop than wheat, oats, and barley, yet in many respects it is unique and for many purposes very valuable. The straw, if of good quality, is usually worth more in the market than the grain. It is an excellent crop with which to seed clovers and grasses, makes quite a satisfactory soiling crop for early summer feeding, and fine fall pasturage for the dairy.

Rye, while not as rich in protein as many of the other grains, still makes a good feeding ration when properly mixed with other grains.

SEEDING AND CULTIVATION

All that has been said regarding the seeding and cultivation of wheat applies equally to rye, except that rye does not require the high state of fertility in the soil necessary for wheat.

ITS SPECIAL USE

Under present conditions the most profitable use for rye is in connection with dairy farming. If the crop is sown in July, immediately following a hay crop, upon land well plowed and thoroughly tilled, it will furnish the best fall pasture for milk production. In the spring such a field of rye will be almost the first green crop on the farm, and can be then fed to the dairy with gratifying

results in milk production. It does not last long as a soiling crop, but is very satisfactory while it lasts, and fills the gap until clover is ready to feed.

BUCKWHEAT

Buckwheat is known as "the poor farmer's friend," because it will grow upon soil so poor as to be worthless for other farm crops; it can be sown after the corn or other crop has failed; it generally yields a good crop in from eight to ten weeks; it can be easily thrashed with the flail; it always cleans the soil of weeds, and leaves it mellow and in good condition for potatoes or other crops. The straw is rich in protein, and most farm stock relish it, while the flour from the grain in the homemade pancake, with a little maple sirup, makes a breakfast dish never yet excelled by the art of the French chef.

While buckwheat responds readily to good treatment, yet it is a fact that the soil may be easily made too rich, with the result that the crop will lodge and fail to ripen.

VARIETIES

There are three principal varieties usually grown: the common Gray, the Silver-hull, and the Japanese. With some exceptions the Silver-hull is the favorite in the market, and brings from ten to fifteen cents per bushel more than other varieties; but all the varieties usually sell readily, and the best price is obtainable as soon as the grain is thrashed.

WHEN TO SOW

The crop should be sown so that it will blossom after the intense heat of the summer has passed. A broiling sun

will blast the blossoms and the drought of summer will prevent ripening. Usually the best time to sow buckwheat is during the latter days of June or the first part of July, and it is frequently sown on soil from which one crop has already been taken in the earlier part of the season. For its proper development it requires a moist, cool climate, which is best secured by a late fall growth, ripening just early enough to escape the frost. If there is imminent danger from frost before the seed has thoroughly ripened, the crop may be cut, and it will be found that most of the immature kernels will afterwards ripen in the swath.

ITS USES

Besides being the poor farmer's best friend, buckwheat is fast becoming a delicacy on the tables of the rich. Its grain is relished by most farm animals, including fowls, swine, horses, and cattle. For these reasons it is doubtful if it has received the attention it richly deserves. It seems to occupy the position of a poor relation among the cereals, existing on soils too unfertile for them, and responds thankfully to a little inferior fertilizer, such as slag or acid rock, actually bringing a crop to the farmer who practices the most shiftless methods of tillage. The inferior methods of some farmers are sometimes alluded to by their more successful neighbors as "having got down to buckwheat."

MILLETS

The millets are cultivated varieties of small seeded cereal grasses, and in this country are grown principally as a supplementary or catch crop. While millet may have a valuable place in certain rotations, it is generally used as a soiling crop, for hay, or for summer pasturage.

VARIETIES

The principle varieties grown in the United States are the Fox-tail, the Barnyard, and the Prosos, or Russian millet. The Fox-tail comprises the common millets and the Hungarian millets; other varieties, including the German, the Japanese, the Aino, the Siberian, the Korean, and others, are often grown for grass, hay, and soiling crops.

The Barnyard millets comprise several varieties which are widely different in characteristics, but all showing sturdy, spreading stems and broad leaves.

The Prosos millets also comprise several varieties which differ in the form, color, and shape of the pinnacle or head, the seed and the leaves. The seeds of all the Prosos varieties are larger than those of any of the others, and vary in color from white to yellow, gray, red, brown, and black. They also represent a wide variation in growth, time of maturity, drought resistance and yield.

NEW VARIETIES

New and improved varieties of millet plants have frequently been introduced, and there seems to be no limit to the variation which the plants will undergo.

PEARL MILLET

Recently a variety called Pearl millet has been introduced which in size is really mammoth, and the yield as a forage crop is simply enormous. Pearl millet grows to a height of from 7 to 10 feet, is surmounted by a head resembling a "cat-tail" from 6 to 14 inches long, can be

cut two or three times during a season, is very succulent when young, but if allowed to head becomes woody, and will not be readily eaten by stock. It is difficult to cure and handle for hay, but if cut when young, makes excellent soiling feed.

ADAPTATION

Millet will grow in almost any climate and upon a great variety of soils, but certain varieties show greater adaptability to peculiar soil conditions than others. For example, Barnyard millet requires much more moisture than those of the other groups, and should be sown on soils moist in character; yet the plant will not grow in a wet soil. The Prosos family, on the other hand, do better in a dry climate, high altitudes, and a rather dry soil, and they are extremely drought resistant.

CULTURE

Millet requires a rich, mellow soil, and the plant foods should be near the surface, as the plant is shallow rooted. The crop is somewhat exhaustive of the food supply in the soil.

SEEDING

About two pecks of seed per acre are required, and the seeding may be done at any time from May first to August first. It may precede a crop such as alfalfa or clover, or may follow a crop such as oats, peas, or rye in the same season.

USES

Millet makes good hay if properly cured; good ensilage if cut green; good soiling crops, good pasture, and is a valuable grain crop. There is always some danger of

overfeeding stock with millet, and the grain should be fed in combination with some other grain and the ensilage in combination with other roughage; otherwise injurious effects may result in the animal's digestive organs. Fatal results have followed overfeeding horses upon such food.

VALUE OF CROP

Altogether millet is a desirable, valuable, and convenient crop for the farmer to raise. It can be sown when time will permit and when other crops are out of the way. It kills all weeds and makes the soil light and mellow. It is seldom affected by insect or fungus enemies. It grows on almost any kind of soil, in almost any climate, seldom fails, and is always useful.

CHAPTER XVI

THE GRASSES

THE number of the grasses is so great that to enumerate them would be useless and to describe them would be well-nigh impossible. A few of the more important ones will be considered because of their economic value and general use in farm practice either as meadows or for pasturage purposes.

TIMOTHY

Of first importance among the grasses stands timothy (*Phleum pratense*). In practice it is commonly grown with red clover, the grass seed being usually sown in the fall with some nurse crop, such as winter wheat or rye, and the clover added in the spring, frequently upon a light fall of snow or when the ground is slightly frozen. The clover may, however, be sown later, when the ground is in good condition to harrow and the seed harrowed in. In practice this has proven not only a good way to seed the clover, but also seems to benefit the grain.

The more recent practice of many farmers is to sow both the timothy and the clover seed together without a nurse crop and late in the summer. When sown in this way, a fall crop of hay is secured the following season, while if sown with a nurse crop, as just described, a crop of hay will not be secured until the second season.

As a matter of fact, timothy seed may be sown upon clover sod at any time during late summer or early fall, if well harrowed in. So also may clover seed be sown upon timothy sod in the spring and harrowed in. In either case a good crop of mixed hay or pasture will result.

QUANTITY OF SEED

If it is desired to secure a mixed crop of about equal parts of timothy and clover, 6 quarts of clover seed and 8 quarts of timothy seed should be sown per acre. If it is of good quality, this quantity should weigh about 24 pounds.

REDTOP

If the land to be seeded is somewhat low and is not well drained, or it has moist places, it may be wise to add 12 pounds of recleaned redtop seed, and if the land is too moist for timothy, it may be wholly replaced by redtop. Such soils are usually more or less sour, and redtop will thrive on acid soil. Such conditions and treatment would necessarily eliminate the red clover, and it might be possible to substitute alsike clover in its place. In case alsike is used in place of red-clover seed, the proper quantity would be about 4 pounds per acre.

ALFALFA SEED

A practical way for a farmer to prepare his land for a future crop of alfalfa is to mix a small quantity of alfalfa seed with the timothy seed when sown in the late summer or fall. The alfalfa seed will germinate, and good plants probably will grow the first season and disappear the second; but some of the bacteria which are essential to the

full development of the alfalfa plant will have been provided, and the soil more or less inoculated and ready for a future seeding of alfalfa.

WHY USE GRASSES IN MEADOWS?

It is always unpleasant and sometimes unsafe to propose a change in the usual order of things, especially if it is in some almost universal practice in agriculture; but the writer can see no advantage in seeding meadows with any crop other than the legumes, *i.e.* some of the clovers or alfalfa. Some of the legumes or a mixture of them will grow upon almost any soil if properly treated and cultivated, and certainly the yield per acre will be much larger without the grasses, while the feeding value per acre will be increased many fold over that produced by any of the grasses. More important still, the legumes will continually enrich the soil, while the grasses will as continually drain it of plant food.

It is often said that horsemen prefer timothy hay to alfalfa or clover for feeding. Unfortunately this is often true — unfortunate for both the horseman and the horse. It is another of the ancient prejudices which must be met and overcome and which is without foundation in fact. Wherever the legume has been successfully grown, its superior feeding value over any of the grasses has been so clearly demonstrated that the question is never seriously argued.

GRASSES NECESSARY FOR PASTURE

Good pasture land, however, should be seeded with such a variety of grasses, well adapted to the soil and locality, as will insure a plentiful supply of succulent, palatable

food for all kinds of stock, from early spring to late fall. A permanent pasture may be secured by sowing a mixture of the following seeds: 4 pounds orchard grass, 4 pounds meadow fescue, 3 pounds tall oat grass, 2 pounds timothy, 2 pounds alsike clover, 2 pounds white clover. Total, 24 pounds.

The purpose of combining these grasses in one field is to have plants which ripen at various periods throughout the entire season, so that stock may always be able to secure good forage. It is evident for the same reasons that such a mixture would be entirely unsuitable for meadow purposes, because none of the plants would develop and ripen with the others.

IMPROVEMENT OF PASTURES

It is well known that the ordinary pasture throughout the country receives very little attention and is of comparatively little value when compared with other farm lands. And yet, with proper seeding and care, the pasture might be made almost as valuable as any other part of the farm. In several of the European countries land valued at from \$2000 to \$3000 per acre has been kept in pasture for generations and at a profit, because it is intelligently seeded and properly treated. It is entirely practicable to reseed pasture with any kind of seed desired without breaking up the soil or injuring the sod; and such pastures can be so handled as to produce an abundance of food for the entire season.

CHAPTER XVII

ROOT CROPS

POTATOES

THE most extensively grown crop in the world (with the possible exception of rice) is potatoes. The value of the potato crop grown in Europe exceeds the value of the wheat crop of the whole world. The United States produces annually in round numbers about 275,000,000 bushels, with an average yield of $84\frac{1}{2}$ bushels per acre.

SOIL

Potatoes are produced in every civilized country and under a wide divergence of climate and soil; but for the most perfect development they require a rather cool climate and a moist, mellow, rich, and well-drained soil. A sandy loam is the ideal soil for this crop, but other soils can be made to produce satisfactory crops by proper treatment. A plentiful supply of humus is necessary for the best results, as such material insures an open, friable soil condition, water-holding capacity, and facilitates the growth and expansion of the tubers. Light soils that are rich in humus produce larger crops and a better quality of potatoes than heavy clay soils.

PREPARING THE SEED BED

Potatoes should be planted on land that has been well tilled the previous season in the growing of some other

crop, and preferably in rotation with other crops such as corn, beets, oats, and clover.

For several reasons, to be noted later on, it is not advisable to plant potatoes on newly plowed sod land, neither should one potato crop follow another in successive seasons. If they must be planted upon sod land, it is advisable to plow the field the previous fall, so that the sod and green vegetable matter may have time to ferment before the potatoes are planted; otherwise there is much danger that the disease known as "potato scab" will attack the tubers. There is also danger in a dry season that the vegetable matter so plowed under will cut off the supply of moisture which the plants should receive from the subsoil and thus injure the crop. In other words, to obtain the best results with potatoes, the sod should be thoroughly rotted. If sod land has been plowed the previous season and a crop of corn grown upon it, which was at the same time treated with a good coat of barnyard manure, and is then followed by potatoes, it will probably be in the best possible condition for the crop.

The danger from planting successive crops of potatoes lies in the fact that disease germs peculiar to the vegetable (such as scab), while present in small numbers the first season, did not have time to so multiply as to destroy or materially injure the crop; but if given a second opportunity at the same crop on the same soil in the following season, their presence in large numbers would be likely to seriously injure the crop. In a general way this reasoning may be applied to every other cultivated annual crop; hence the necessity of crop rotation.

The best results in potato cultivation are usually ob-

tained by plowing as deep as the nature of the soil will permit, the previous fall, plowing again in the spring as early as possible, and putting the soil in the best of tilth without delay. This treatment will go far toward conserving the moisture in the soil and will also aid in securing a mellow seed bed.

FERTILIZERS

There is no crop which responds more readily to fertilizers than potatoes, and in common with most farm crops, there is no fertilizer equal to barnyard manure. Fresh barnyard manure should not, however, be applied directly to the potato crop, but to the preceding crop in the rotation, because the direct application of unrotted manure will largely increase the danger from scab. If barnyard manure has not been applied to the preceding crop, and well-rotted manure is not available, then resort must be had to commercial fertilizers. Many successful potato growers make heavy applications of these fertilizers, with generally good results, using the following formula: nitrogen, 4.00 per cent; available phosphoric acid, 8.00 per cent; potash, 10.00 per cent; quantity applied per acre, 300 to 400 pounds. Many manufacturers of commercial fertilizers advertise compounds for which they claim special merit for potatoes, but it is always well to remember that such compounds are profitable or desirable only as far as they are adapted to the needs of the soil in any given locality. What is good for one locality, or even for one farm, may not be good for another locality, or even for an adjoining farm. It all depends upon the condition of the soil and the quantity of available plant food naturally contained in it. This can only be determined by experiment.

SEED SELECTION

It is generally believed by potato growers that a good, vigorous variety of potato will "run out" after a few years of constant reproduction in a given locality. Under ordinary methods of management this is probably true; but the fault is not with the potato, but with the man who selects the seed from year to year.

Seed potatoes should not be selected from the bin, however large and perfect the specimens, but in the field at harvest time, and from the largest, most vigorous, and best-yielding hills, taking into the account also the size and thrift of the vines as well as the size and number of tubers in the hill. If only such potatoes were selected and stored in a cool place until planting time, then properly planted and tilled, there would be no more "run out" potatoes, but a constant improvement in the quality and quantity of the crop.

PREPARING THE SEED

Only the large, plump, vigorous potatoes should be selected for seed, discarding all shriveled and sprouted specimens. To guard against scab, the seed must be treated before planting. This may be done by dissolving 4 ounces of corrosive sublimate in 30 gallons of water and suspending the seed in a loose bag submerged in the mixture for one hour; then raise them and allow to drain and dry.

HOW TO CUT SEED POTATOES

Experiments conclusively prove that the most profitable potato crop is secured by selecting such potatoes as will, when cut into halves, show a weight of at least 4 ounces.

The seed should be cut through the long diameter, *i.e.* from the small end to the large end. Other things being equal, the yield of the crop will be reduced just in proportion to the reduction in size of the seed pieces.

The young shoot must subsist for the first few days after it begins to grow upon the starch stored in the parent seed. If that food is abundantly supplied by a large piece, the shoot will start strong and take hold of the soil food rapidly and vigorously. If the seed piece is small, the shoot will be slow to start, and never be as vigorous as it should be.

HOW TO PLANT THE SEED

The tubers grow on branches that spring out from joints formed on the main stems between the sets and the surface of the ground. It is therefore important that the sets be placed at a proper depth so that the tubers may develop without coming to the surface. It is also important because deep planting allows of level tillage, which is generally desirable where possible.

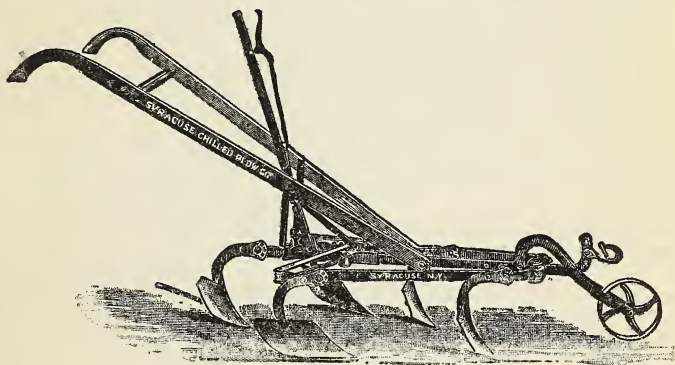
The soil should now be opened in straight rows 3 feet apart and at least 6 inches deep by means of a double mold-board plow, piling the soil up in ridges on each side. When the field is thus furrowed, the sets may be dropped about 18 inches apart in the row. The plow may then be used to split the ridges and fill the furrows, which is a rapid way to cover the seed.

CULTIVATING THE CROP

Before the plants reach the surface, the whole field should be harrowed at least twice, using a light spike-tooth harrow. When the plants are all well up, harrow

the field a third time, which will destroy all early weeds and maintain a fine mulch, which will conserve the moisture for the use of the plants

As soon as the rows can be followed, the cultivator should be started, going close to the plants the first time and quite deep. At each subsequent cultivation the culti-



A good style of cultivator for use in potatoes.

vator should be kept a little farther from the plants and cut a little more shallow. The reason for this is clear when it is recalled that the plant roots soon fill the whole area of the soil to within 3 inches of the surface. This work should continue until at least 7 or 8 thorough cultivations have been given and until the vines cover the major part of the ground. Cultivate as soon after rain as the soil is in fit condition.

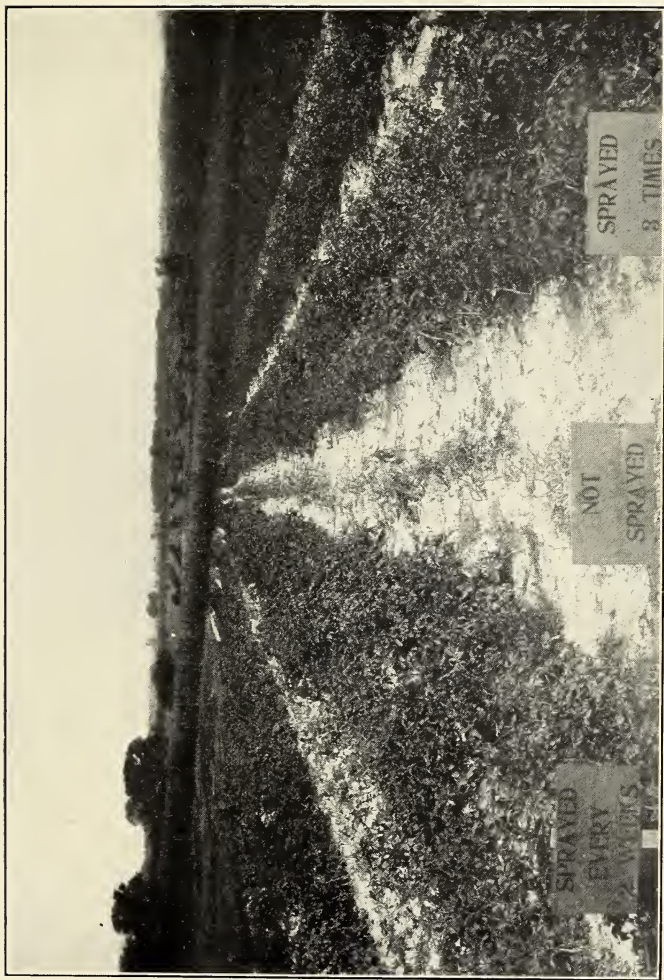
SPRAYING POTATOES

When the plants are 5 or 6 inches high, they should be sprayed with a Bordeaux mixture to prevent early blight

from attacking the crop, and again when they reach a growth of 10 or 12 inches. This spray mixture should contain also Paris green in order to exterminate any potato beetles or other chewing insects that are liable to injure the crop. Later still, and after the plants have shed their blossoms, a third application should be given to prevent the disease called late blight; and if necessary, a fourth application should be given. The wise husbandman will not wait for signs of blight to appear, because the whole crop may be cut down in a day or two and before it is possible to apply the remedy. The Bordeaux mixture will not injure the plants. In fact, it is claimed by some that the treatment is actually beneficial. At all events, the potato grower cannot afford to take chances. The usual spray mixture for potatoes is made as follows: 5 pounds copper sulphate (blue vitriol), 5 pounds quicklime, and 50 gallons of water.

TO PREPARE THE MIXTURE

Put 30 or 40 gallons of water in a barrel and suspend in it the copper sulphate tied in a cheese-cloth bag so that it will be entirely submerged near the top of the water. A little time will be required to dissolve the substance, which will settle to the bottom of the barrel. Prepare the lime by slaking with hot water, adding a little at a time, so that the lime will crumble into a fine powder. When the lime is completely slaked, add cold water sufficient to convert it into a thin, milky solution. Pour this into the barrel containing the copper sulphate, stirring and mixing it thoroughly. Then add water sufficient to make 50 gallons. This mixture should be applied fresh



EXPERIMENT IN POTATO SPRAYING.

Gain resulting from spraying every two weeks in 1904, 233 bushels per acre.

By courtesy New York State Experimental Station, Geneva, N.Y.

and should be constantly agitated while being applied. If Paris green is to be applied, a pound may be put into the mixture dry and thoroughly mixed before using.

TESTING THE MIXTURE

It sometimes happens that lime varies in strength and that consequently the proper proportions in weight do not give the right chemical proportions. To determine whether sufficient lime is present, put an ounce of yellow prussiate of potash in a pint bottle and fill with water. When dissolved, let a drop fall upon the spraying mixture, and if insufficient lime is present, the ferrocyanide solution will turn brown. Then add more milk of lime until it will not turn brown when dropped upon the mixture. Still a little more lime added will do no harm. It is wise to strain the milk of lime before it is added to the mixture to prevent the spraying nozzle from becoming clogged.

OTHER USES OF THE MIXTURE

The mixture described above may also be used for controlling diseases in other plants and shrubs, among which may be named the following: apple scab, apple tree canker, asparagus rust, leaf spot of beets, leaf spot of celery, leaf spot of cherry, cucumber mildew, leaf spot of currant, ginseng blight, black rot of grapes, mildew of grapes, hollyhock rust, onion mildew, leaf curl of peach, leaf spot and scab of pear, leaf spot of plum, leaf spot of quince, anthracnose of raspberry, black spot of rose, leaf spot of tomato, and leaf spot of strawberry. The spraying mixture should be applied with some force so as to produce a perfect spray. It should not be applied in sufficient

quantity to form a drench, yet every part of the plant should be covered.

CAUTION

Never spray any plant while in bloom. Such treatment destroys most of the blossoms and poisons and kills the bees, preventing pollenization and fertilization, causing crop failure.

CHAPTER XVIII

ROOT CROPS FOR STOCK FEEDING

THE production of root crops should not be confined to the market, but should be of vital interest to the dairyman and stock grower as well. The dairy farmer and stock raiser of the Atlantic States usually produce large quantities of roughage, such as hay, straw, and corn fodder, but are compelled to purchase a portion, at least, of the grain and concentrates fed upon their farms. These concentrates are generally costly, and the purchase of sufficient quantities to supply the dairy and growing stock is always more or less burdensome.

It is the purpose of this chapter to demonstrate how it is possible to substitute, to a large extent, the home-grown root crop as a feeding ration in place of the grain ration heretofore so largely used, and to suggest the most desirable kinds for this purpose and how to grow them.

FEEDING VALUE

The feeding value of roots is not to be judged by quantity or volume of raw material, but is indicated by the amount of dry matter. To illustrate, 65 pounds of mangels contain $7\frac{1}{2}$ pounds of dry matter, equal in feeding value to $7\frac{1}{2}$ pounds of cereal grains, or $5\frac{5}{8}$ pounds of cottonseed meal. It therefore follows, that if a ton of dry matter can be produced for less money than is required to purchase a ton of concentrates, it will be the part of

wisdom to produce such feeds and avoid the purchase of the higher-priced ones.

There is also the further question which is worthy of consideration, to wit: Roots as food are highly digestible, even more so than cereal grains; they have a high net available energy in themselves, and, in addition to that, appear to render all other portions of the feed ration more perfectly and easily digestible, thus adding value to the whole. The effect of feeding roots may be observed in the improved tone and healthfulness of the animal.

Extensive Danish experiments in feeding milch cows, carried on for several months, where large quantities of roots were used as a part of the feed ration, seemed to prove the desirability of including them in a feeding ration. The cows were fed roughage consisting of 6½ pounds of hay, 10 pounds of straw, and the following ration:—

	CEREAL GRAINS	COTTON SEED MEAL	DRY MATTER IN MANGLES	NUTRITIVE RATIO	DAILY YIELD OF MILK
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>		<i>Pounds</i>
First lot . . .	7	1.5	4.5	1:8-9	22.4
Second lot . . .	4	4.5	4.5	1:5-5-5	23.7
Third lot . . .	4	1.5	7.5	1:8-9	22.5
Fourth lot . . .	1	4.5	7.5	1:5-5-5	24.2

It is interesting to note that the first lot were fed 7 pounds of grain and 40 pounds of fresh mangels, equal to 4.5 pounds of dry matter, and that the third lot were fed 4 pounds of grain and 65 pounds of mangels, equal to 7.5 pounds of dry matter. In other words, the grain ration was reduced by 3 pounds and the dry matter

in the quantity of mangels fed increased by 3 pounds, with the result that the yield of milk was actually increased.

As one feature of experience many dairymen have demonstrated that with good, well-cured legumes, such as alfalfa and clover, fed in connection with well-eared and fully developed corn ensilage, the cereal grains may be entirely dispensed with, if plenty of roots are substituted in the feeding ration, and that the milk flow will actually increase.

KINDS OF ROOTS

The following table shows the average yield per acre of several kinds of roots grown upon the experimental farm of the College of Agriculture at Cornell during the seasons of 1904, 1905, and 1906. The average yield of dry matter per acre as well as the percentage of dry matter in the several varieties of roots are also given:—

AVERAGE

	1904		1905		1906		AVERAGE	
	Fresh Sub- stance Tons	Dry Sub- stance Lbs.	Fresh Sub- stance Tons	Dry Sub- stance Lbs.	Fresh Sub- stance Tons	Dry Sub- stance Lbs.	Fresh Sub- stance Tons	Dry Sub- stance Lbs.
Mangels . . .	20.8	4726	26.2	5800	23.9	4940	23.6	5155
Half sugar . .	—	—	29.6	6580	23.6	5180	26.6	5880
Sugar beets . .	—	—	26.9	8120	20.7	6060	23.8	7090
Carrots . . .	9.6	3181	16.8	3720	11.3	2500	12.6	3134
Rutabagas . .	17.1	3074	25.8	4820	26.0	5100	23.0	4331
Hybrid turnips	21.4	3561	24.7	4120	18.1	3400	21.4	3694
Turnips . . .	5.6	—	20.9	3380	12.1	1980	12.9	2680
Kohl-rabi . .	—	—	22.3	4480	20.0	3660	21.2	4070
Cabbages . .	43.8	6206	29.0	3640	22.5	4140	31.8	4662
Parsnips . .	—	—	8.0	3240	8.1	3020	8.1	3130

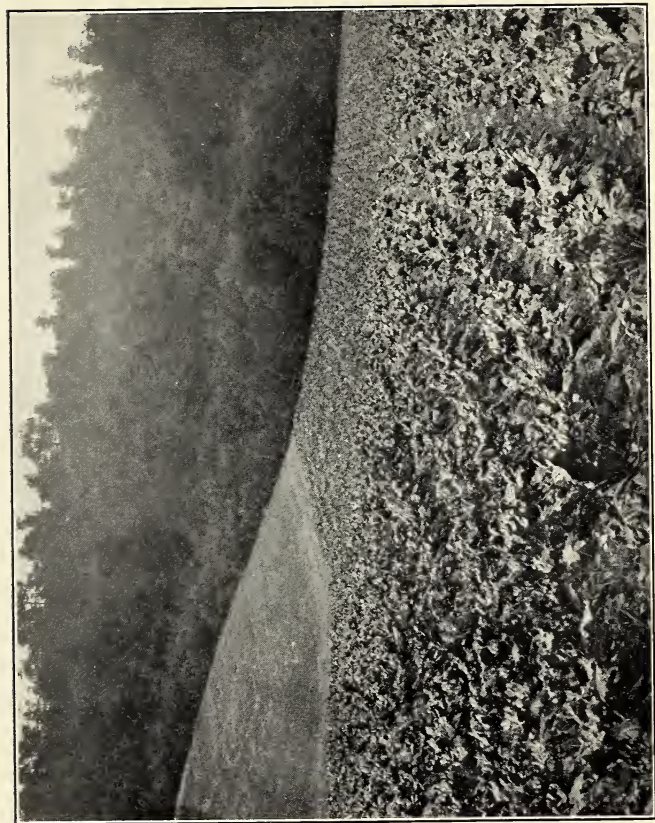
As before observed, the feeding of roots depends not so much upon the number of tons per acre, as upon the quantity of dry matter contained in an acre of the crop, and the foregoing table shows sugar beets to be in this respect far ahead of all other roots. Sugar beets, however, are very difficult to harvest because of their habit of growing deep in the soil, while some of the other varieties grow substantially on the surface and are therefore easily and cheaply harvested. In fact, the difficulty in harvesting sugar beets is believed to more than offset their greater value as stock food. Furthermore, they do not keep so well as mangels.

SOILS FOR MANGELS

Almost all productive soils will produce mangels, but deep loams are best for the production of the deep-growing varieties. If the soil is light or shallow, such varieties as the Globe or the Tankard should be selected.

The soil should be plowed deep, in the fall, following some grain crop or corn, and thoroughly disked or harrowed the following spring. No crop responds more satisfactorily to good tillage than mangels, and five or six good harrowings will often be required to make the seed bed fine.

If the soil has been treated to 10 or 12 tons of barnyard manure per acre, it would be wise to broadcast 250 pounds of acid phosphate, 110 pounds of nitrate of soda, and 120 pounds of muriate of potash per acre, well mixed just before being applied and just previous to the last three harrowings. If the land is sour, it should be treated with 1500 pounds of finely slaked quicklime, applied before the harrowing is commenced.



MANGEL WURZEL BEETS.

Yield 1250 bushels per acre. New York State School of Agriculture, Alfred, N.Y.



SEEDING MANGELS

The seed should be sown early in May in drills 30 inches apart, at the rate of 6 to 8 pounds per acre, and should never be covered to a depth of more than $\frac{3}{4}$ of an inch. A deeper planting will cause the seed to rot, and few plants will reach the surface.

CULTIVATION

As soon as the rows can be seen, shallow cultivation should be commenced close up to the plants, in order that any crust which may have formed may be broken; otherwise many of the tender plants will be unable to come through.

While the plants are small, shields should be used upon the cultivator to prevent the soil from being thrown upon and covering the plants.

THINNING

As soon as the plants have four leaves, they should be thinned. This labor may be materially reduced by sharpening a hoe and "chopping out" the plants so that a bunch will be left growing at distances of 10 or 12 inches apart. The bunches will require hand thinning, and this must be done carefully, leaving the largest plant in the bunch, pulling out all the others. Thinning must be done at the proper time, as a few days of crowding will result in stunted plants and permanent injury.

It is important that the crop should be kept ahead of all weeds, and if the growth seems slow, the application at this time of 50 pounds of nitrate of soda and 50 pounds of acid phosphate, applied when the leaves are dry, would

probably cause a quick start. Good, thorough tillage at intervals of 10 or 12 days, and always as soon as the soil is fit after every rain, will insure a good crop of mangels.

HARVESTING

Mangels should be harvested before frosts occur. When the outer leaves begin to wither, the plants have ceased to grow. The roots should be pulled, topped, placed in the wagon and drawn directly to the root cellar, with as little handling and bruising as possible. The storehouse should be well protected from frost, but always cool and well ventilated.

The roots will keep well all winter, and may be fed with profit to almost every animal on the farm. They may be fed whole to swine, but should be cut for horses, cattle, and sheep. A very satisfactory hand or power root cutter can be purchased for \$10.

SUGAR BEETS

The directions given for the treatment of the soil, seeding, and cultivation of mangels apply in all respects to sugar beets, except that harvest time arrives earlier and may usually be commenced by the middle of September.

ROTATION CROPS

It is proper to state here that sugar beets, as well as all other root crops, should be grown in rotation with other crops in order to avoid the various diseases which are likely to attack root crops when planted upon the same soil for several successive seasons.

HALF-SUGAR MANGEL

The half-sugar mangel is a cross between the sugar beet and the mangel. It resulted from an attempt to secure a mangel with a higher dry matter content while still retaining the heavy yielding quality of the mangel. This cross has not met expectations, but a very useful feeding plant has been developed. The same treatment should be given this plant as described for mangels.

CARROTS

THE SOIL

The ideal soil for carrots is a deep, well pulverized, sandy loam, free from weeds. The stump-rooted varieties, however, may be successfully grown on shallow soils. The soil should be fitted in substantially the same manner as before described for mangels, except that the manure should be applied to the preceding crop, so that all weed seeds may have been killed. The reason for this is that the carrot plant is so slow in germinating that it is difficult to prevent the growth of weeds before the plants secure a start.

THE SEED

The slow germination of carrot seed makes it advisable to start the process before planting. This may be done by placing the seed in a box in a warm room and moistening it with warm water every day for several days until germination begins. The seed may then be dried in sand or by passing a draft of air through it; it will then be ready to sow. From 3 to 6 pounds per acre is the usual quantity planted, depending on the purity of the seed. The rows

should be 30 inches apart. The crop must be thinned as soon as the plants are large enough, and always kept free from weeds. During the first two months a light dressing of fertilizers should be applied, consisting of 50 pounds of nitrate of soda and 50 pounds of acid phosphate per acre; it should be well worked into the soil near the plants.

FEEDING VALUE OF CARROTS

The feeding value of carrots for horses is very high when fed in conjunction with cereal grains such as oats. A feed of carrots alternating with a feed of oats proves equally satisfactory, as if the entire quantity of material fed was oats. In other words, a bushel of carrots is equal to a bushel of oats in feeding value, when fed to work horses in equal alternating quantities. The carrot tops, unlike those of many roots, are exceedingly valuable as food, and should always be secured for that purpose, for they will add at least four tons per acre to the yield.

TURNIPS AND RUTABAGAS

The turnip is a biennial plant and comprises many varieties, but the best-known types are the common turnip and the rutabaga. The turnip may be distinguished from the rutabaga by its grass-green leaves covered with rough hairs, no neck, small yellow flowers, smooth roots, poor in keeping quality, weighs from 3 to 12 ounces, and develops in from 60 to 90 days; while the rutabaga has smooth leaves of bluish green, a neck, large buff-yellow or pale orange flowers, rough roots, good keeping qualities, weighs from 16 to 50 ounces, and requires from 90 to 180 days to develop.

Both turnips and rutabagas seed the second year, sending up a strong stem which branches and bears heavily of seed.

HYBRID TURNIP

The hybrid turnip is a cross between the turnip and the rutabaga, and may resemble one or both of them in various respects. Some varieties, like the Garton Pioneer, have all the appearances of the rutabaga, with its good keeping qualities, but develop sooner.

THE SHAPE OF TURNIPS AND RUTABAGAS

Almost every conceivable shape is represented by the roots of these plants. Some taper from the shoulder to the tip; others taper from the middle to both the shoulder and the tip; some present a long body with parallel sides; others are oval, others round, and still others flat. Certain varieties grow deep in the soil and others sit on the surface.

THE SOIL

Turnips thrive best on good, rich, friable soil, while rutabagas do best on rather heavy loams. The root system of these plants grows near the surface; hence, in very light soils they are liable to suffer from drought. Plenty of moisture is requisite to secure a satisfactory crop.

THE CLIMATE

A favorable climate for these roots is quite as important as proper soil, if satisfactory development is to follow. The moist, cool climate of some of the European countries may account in a measure for the great popularity of these plants as stock foods in those countries.

PREPARING THE LAND

In a general way the land should be prepared, fertilized, and limed as for mangels, but a mixture of 500 pounds of acid phosphate and 75 pounds of nitrate of soda should be applied and well worked into the soil before planting the seed.

THE SEED

The seeds of these plants are very small, and 3 or 4 pounds per acre will be found sufficient if the seed is pure and of good quality. It should be sown in drills 30 inches apart and from $\frac{1}{2}$ to $\frac{1}{4}$ of an inch deep. The plants should be up by the middle of May and immediately thinned to 7 inches apart in the row.

CULTIVATION

The crop should be kept free from weeds by frequent cultivation, and as the crop develops rapidly, the cultivation should be repeated at least once a week if the best results are secured.

The common turnip keeps only a short time and should be fed in the fall and early winter. The hybrid turnip can be fed after the common turnip, and the rutabaga at any time during the winter.

GROWING TURNIPS IN CORN

In many parts of the country, especially in the North Atlantic States, the practice of sowing turnips between corn rows at the time of the last cultivation of the corn crop has been somewhat popular. There is no doubt that large quantities of turnips are thus grown with very little additional labor and expense. But as a general rule such

practice is not to be commended because it is believed that the corn crop is robbed of just so much plant food as is secured by the rival crop, and that any gain in total yield is more apparent than real. However, the question is an open one, and there is need of careful experiment to gain definite information in this direction.

CABBAGE

It would seem to be a wise course for every dairy farmer to raise a field of cabbages every year. The crop usually brings a reasonable price in market, and frequently the demand is so great that a cabbage crop brings the largest return of anything grown upon the farm. The farmer should always be prepared to take advantage of such market conditions. If, however, as sometimes happens, there is little or no market demand for the crop, the thrifty farmer still has his own home market, and his crop may be fed to his stock and converted into dairy products to good advantage.

It is estimated, that as a soiling crop to be fed from the field in the fall, or as a winter ration supplying a succulent, palatable food for stock, cabbages are worth at least \$5 per ton. The crop is a milk producer of the first importance, and is only second in value to the best root crops as a feeding ration for sheep, swine, and poultry. True, the crop presents some objections, when compared with well-known root crops, as a stock-feeding ration. It is more expensive to plant, more difficult to store, requires larger quantities of plant food, and contains a smaller quantity of dry matter. Yet, considering the very high price frequently obtained for it, it is a question whether the

cabbage crop, one year with another, is not one of the best the farmer can raise.

CLIMATE CONDITIONS

Cabbage will grow under a wide range of climatic conditions, but the best results are obtained in a moist, cool climate like that of the Northern States and Canada.

THE SOIL

Unlike most farm crops, cabbage will thrive on almost any kind of soil, provided a sufficient quantity of plant food is supplied, and sandy, clay, or muck soil will show almost equally good results, if properly prepared, fertilized, and tilled.

PREPARING THE SOIL

During the winter and early spring, barnyard manure should be applied to the soil at the rate of at least 10 tons per acre, and even more if the soil is thought to be deficient in humus. As soon as the land is sufficiently dry in the spring to work, slaked quicklime should be applied at the rate of 1500 pounds per acre and the land then thoroughly disked in two directions. When this is done, the soil should be treated to a mixture consisting of 150 pounds of phosphoric acid, 120 pounds of muriate of potash, and 50 pounds of nitrate of soda. The soil should now be thoroughly and deeply harrowed, lengthwise, crosswise, and cornerwise, until it presents a fine mellow surface.

THE SEED

If it is desired to seed the crop direct, it should be done early in May, in rows 3 feet apart, in which case the plants

must be thinned when 3 or 4 inches high, so that they will stand in the row 2 feet apart. This will permit of horse cultivation and lessen the cost of the crop.

RESETTING PLANTS

It is common practice where small areas only are cultivated to grow the young plants in the greenhouse or in boxes under cover, and then transplant them to the field in their permanent position.

If this plan is adopted, the first of June will be found the most desirable time to do the work. Early sown or early planted cabbage will head better, escape its enemies more successfully, and contain more dry matter than if later sown.

CULTIVATING THE CROP

As soon as it is possible to follow the rows, the cultivator should be started close to the plants and deep at first, but a little farther away and shallower at each subsequent cultivation. This should be continued until the leaves so cover the ground that they are injured by the passing cultivator.

If the young plants fail to grow promptly, an application of nitrate of soda at the rate of 50 pounds per acre will start the growth. This should never be applied when the leaves are wet, and should be hoed in about the plants.

If the market for cabbage is not satisfactory, and the crop is not fed to the stock, and proper storage is not at hand in the farm buildings, the crop may be secured for the winter by selecting a grassy spot below the brow of a hill, where snow usually drifts in winter, and there placing the cabbage on the grass, heads down, roots up, in one

single layer (not one piled above the other) and covering it with a few inches of straw or other waste from the barn. In the spring they will be found sound and fresh, when the market may be good. If not, the dairy and poultry will give good returns for the crop.

CHAPTER XIX

CROP ROTATION

It seems scarcely necessary in a work of this kind to remind the farmer that, from every consideration, crop rotation is essential to his continued and best success. It is true that the fertile soil of new countries will produce the same crop for several successive years with little reduction in the yield, but the time will surely come when the soil will refuse to longer produce a given crop profitably, and the risk and loss from disease and crop enemies of various kinds become largely increased.

Over large areas of our country the one-crop system has been followed until profitable crops are no longer possible. The wheat and corn belts of the West and the cotton region of the South are striking examples of the ruinous results of such methods of culture. In much of the territory of both the crop has ceased to return a profit, and in many places impossible to grow, because of the diseases and enemies with which the soil has become infected. The soil itself is not necessarily exhausted, but the plant food required by that particular crop is used up, and the enemies of that crop have there established a permanent foothold.

The remedy is a change of crops. In other words, crop rotation. If the boll weevil infests the cotton field and smut the wheat field, it is utter folly to continue to supply

cotton and wheat plants for those pests to feed upon, when corn, potatoes, or clover may be profitably grown instead. Of course this involves a change of system, and may resolve itself into dairy farming or stock raising instead of grain and cotton growing; but the improvement will be readily observed, not alone in the soil, but in successful crops as well.

There is little doubt that dairying is the business best adapted to keep up the fertility of the soil if the manure produced is judiciously handled; but a system of rotation which will provide a cover crop to be plowed under every two or three years will largely solve the question of soil fertility.

It is impossible to prescribe any fixed system of rotation which will be perfectly adapted to every locality and to varying conditions of climate; in each the farmer must work out the problem for himself; but in each locality there will be found certain crops suited to local conditions, and from such crops a satisfactory rotation can be selected.

In the Northern and Eastern States a very common practice among those who have adopted a system of rotation is to plant corn upon the newly broken meadow or pasture, to be followed by potatoes and other roots the ensuing season. The third season the land is sown to wheat, oats, or barley and seeded to clover. The fourth year the clover is cut for hay, and in the fifth year it is plowed under and corn is again planted.

In this way the whole farm is gone over, and the various diseases and enemies common to each crop do not have time to become permanently incorporated in the soil. The plant foods not required by one crop are appropriated

by some succeeding crop, and the whole farm thus secures a valuable application of vegetable matter once in every four years.

In the cotton belt, cotton might well replace the potato or grain crop in the rotation, and cowpeas could well take the place of the clovers.

The combinations which it is possible and profitable to make with various crops under the varying conditions of soil and climate of our country afford a splendid opportunity for every farmer to exercise his judgment and ingenuity in securing the system best adapted to the conditions which surround him.

PART II

ANIMAL HUSBANDRY

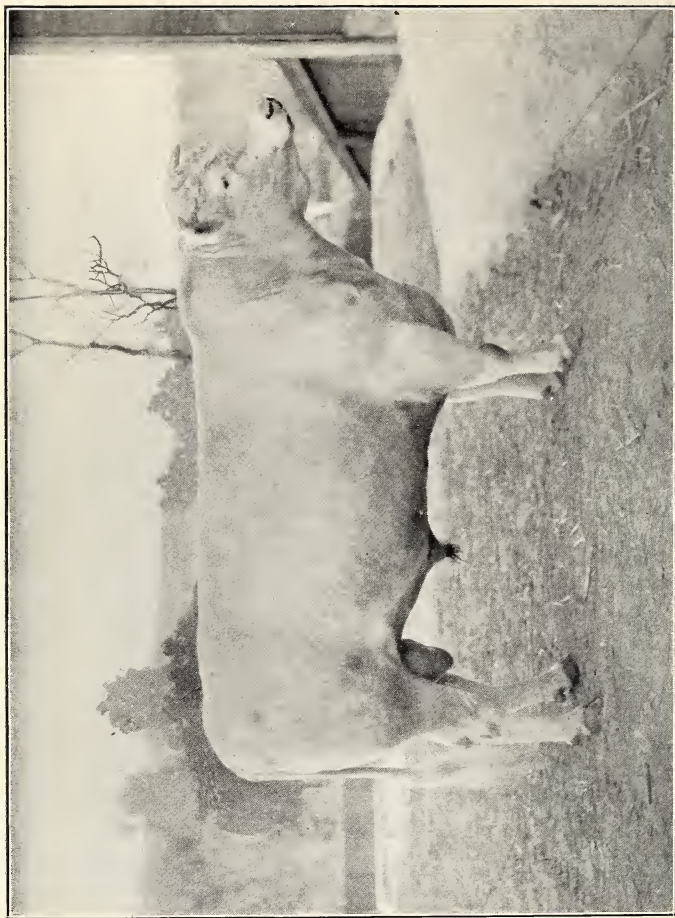
CHAPTER XX

FEEDING FARM ANIMALS

ONE of the most important and least understood subjects connected with farming is the proper feeding of the animals upon the farm, and it is gratifying to note the widespread and increasing interest now being shown by the farmers and stock raisers throughout the country in this important subject. The writer is besieged almost daily by letters and personal calls for formulas of balanced rations adapted to the needs of the inquirers, and it is a fact that every experimental station and agricultural school in the country is receiving requests for, and is supplying, similar information.

KIND OF FOOD REQUIRED BY VARIOUS ANIMALS

The farmer need not be told that his horses require different feeding treatment from his dairy cows, nor that his sheep, swine, and fattening steers must receive quite different treatment from that given his cows; but the information which he lacks and which would be most useful to him is how to feed his different kinds of animals so as to obtain the best and most economic results from



LAVENDER CLIPPER.

Short Horn Bull owned at Woodhill Farm, Long Lake, Minn.

such foods as he may have or can most advantageously procure.

PRINCIPLES OF FEEDING

There is little doubt that there is a vast waste in all parts of the country resulting from improper feeding, as well as unsatisfactory and often injurious consequences. The feeding of farm animals, like the use of fertilizers for crops, rests upon well-defined principles.

Our knowledge of these principles has been derived from the studies of the chemist and the animal physiologist in the composition and functions of food and the way in which it is utilized after it is eaten. It is well known that the tissues of which the animal body is composed are constantly breaking down and being consumed (burned up) and are passing off as waste material, and that new material must be supplied in the food if the animal is to be kept in a healthy condition. To replace the waste constantly going on is the chief function of food, but in addition to this there must be food supplied to keep up the heat of the body and generate the energy necessary to perform the various muscular movements and bodily functions.

Besides repairing the waste of the animal system and supplying the heat and energy, growth is to be provided for in young animals, milk secreted in cows, fat put on in beef, pork, or mutton, and work to be performed by horses, all of which require an additional supply of food.

To supply food in the right proportions to meet the various requirements of the animal, without waste, constitutes scientific feeding.

The correct principles of feeding farm animals have been

worked out by a careful study of the composition of food stuffs, the proportions in which they are best digested by different animals, and the requirements of animals when at rest, at work, giving milk, producing wool, fat, or growth.

In applying these principles the feeder should not lose sight of the fact that some foods are especially adapted to certain animals; that "palatability," or the food which the animal enjoys, is an important factor. Most important of all is the good judgment and general adaptability of the feeder for his work. A balanced ration can never take the place of good judgment, good treatment, and kindness; but the feeder who adds to his other good qualities a thorough knowledge of how to compound his feeds becomes the most valuable acquisition to the farm.

COMPOSITION OF THE ANIMAL BODY

Water is an essential constituent of the animal body, and constitutes from 40 to 60 per cent of its live weight.

Ash constitutes from 2 to 5 per cent of the body, and occurs mainly in the bones.

Fat varies greatly with the condition of the animal, and may comprise from 5 to 30 per cent of the total weight.

Protein includes all of the nitrogenous material found in the body. All of the working parts of the body, such as the skin, muscles, brain, nerves, and internal organs, contain large proportions of protein. Protein is a general term covering a group of substances, familiar forms of which are seen in the white of the egg, lean meat, and the casein of milk. Under the term "protein" is also included a class of compounds known as albumenoids.

COMPOSITION OF FEEDING MATERIAL

The same four groups of substances found in the bodies of animals, as noted above, to wit, water, ash, fat, and protein, are also found in the food they eat, and in addition to these the food of farm animals contains a class of materials known as carbohydrates.

WATER

Water is always present in feeding stuffs, no matter how dry they may seem, and may amount to 10 or 15 per cent, as in hay, straw, or grain, and may be present to the extent of 80 or 90 per cent, as in green corn fodder or roots. While water may add to the palatability of foods, it has no feeding value, and is of no more use in feed than if drunk from the watering trough. It is therefore evident that a comparison of the different kinds of foods must be made on the basis of dry-matter content. *That is to say, the percentage of dry matter must be given on a water-free basis.*

ASH

Ash in feeding stuffs represents what would remain if all of the combustible material were burned out. It consists largely of lime, magnesia, potash, soda, iron, chlorine and carbonic, sulphuric, and phosphoric acids. It is used largely in making bones. It is at once apparent that young animals require foods containing a generous percentage of ash in order to enable them to build up the bony structure of the body.

FATS

The substance which can be dissolved out from the feeding material by ether is called fat, and when consumed

by the animal is burned as fuel to furnish heat and energy. If more is fed than is required for those purposes, the surplus is stored up in the body, and the animal is then said to be "taking on flesh." If, now, the fat-producing foods are withdrawn, the animal will draw upon the stored-up fat and gradually become lean.

CARBOHYDRATES

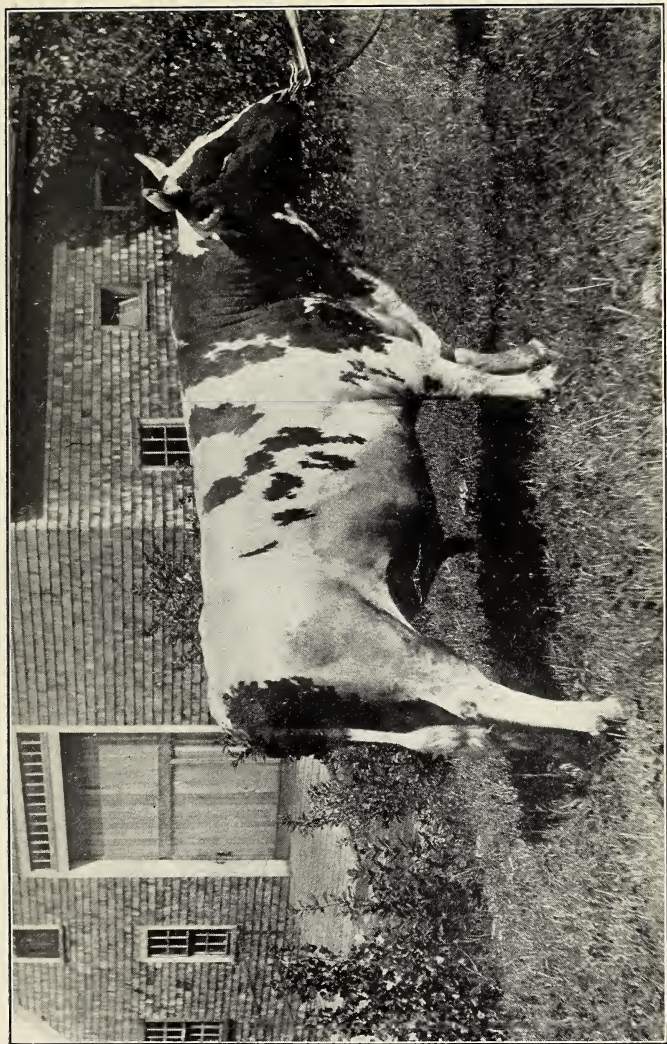
The carbohydrates in feeding material comprise the bulky portion of the food, and are made up of the cell walls and framework of plants. This class includes the cellulose and various other substances, as well as what is known as "crude fiber." Stored in the cells are also found starch and various kinds of sugars.

In an analysis of feeding stuffs these, with a variety of other substances, are included in the term, "nitrogen-free-extract."

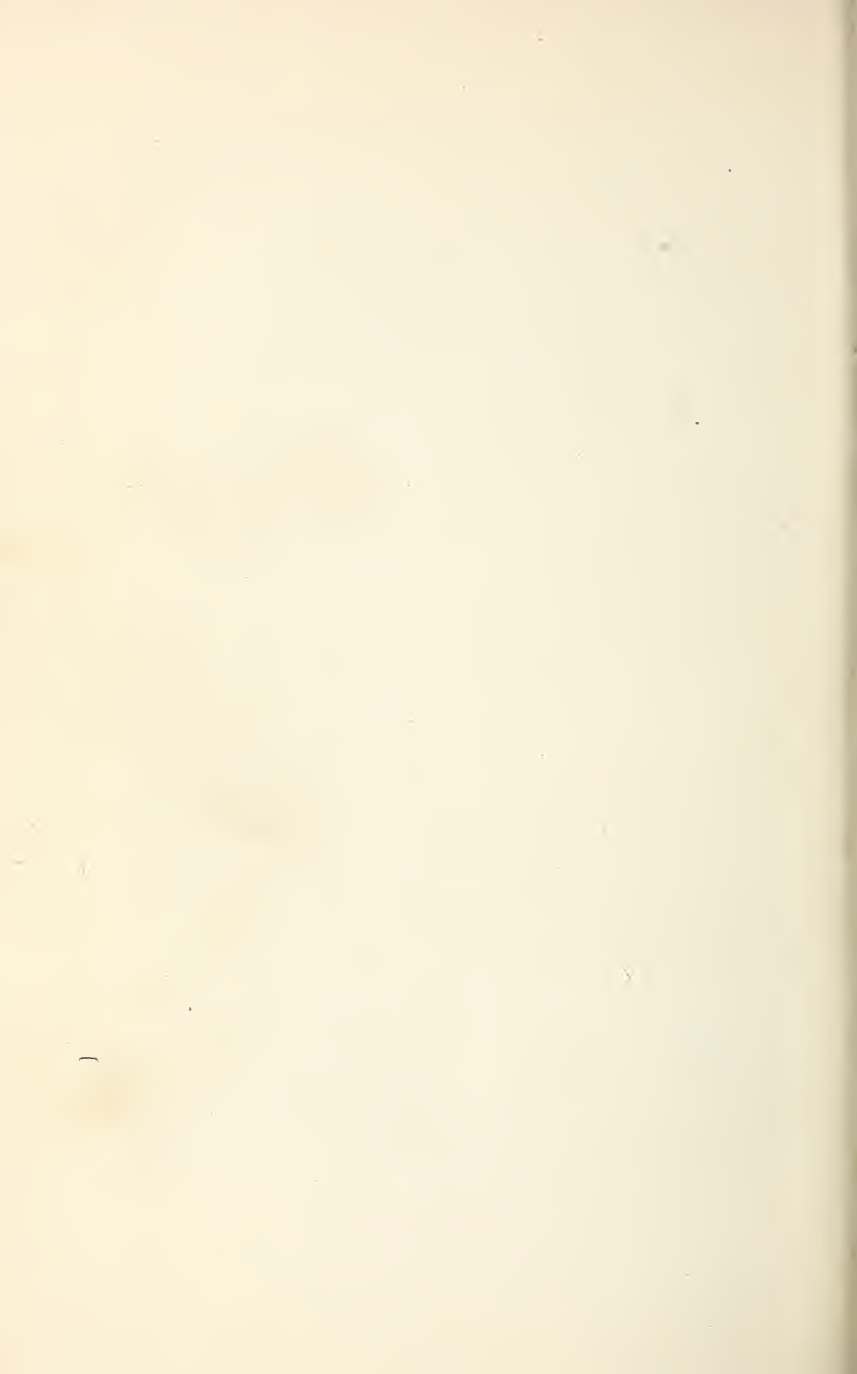
For all practical purposes the fats and the carbohydrates serve nearly the same purpose in the animal economy, and therefore are usually grouped together. The fats, however, are about $2\frac{1}{4}$ times as effective as the carbohydrates; hence, it is customary to multiply the fat by $2\frac{1}{4}$, thus reducing it to an equivalent of the carbohydrates, and then add the amount to the carbohydrates.

COMPOUNDING OF RATIONS

Nutritive ratio. — Since the protein on the one hand, and the carbohydrates and fat on the other, serve, in the main, different purposes in the animal economy, it becomes evident that the relative amounts of these nutrients in the food are important. This relation is expressed as



Imp. Howie's Dairy King.
Champion Ayrshire bull.
By courtesy of the Lotus Fields.



the "nutritive ratio," which means the relation of digestible protein to digestible carbohydrates and fat — the fat having been multiplied by $2\frac{1}{4}$ before adding to the carbohydrates as explained above. The nutritive ratio is found by dividing the carbohydrates, plus $2\frac{1}{4}$ times the fat, by the protein. In the accompanying table, No. II, the sum of the carbohydrates and fat, thus obtained, divided by the protein, gives the second term of the nutritive ratio.

A feeding stuff having a large proportion of carbohydrates and fat, as compared to protein, is said to have a "wide" nutritive ratio, while one having a small proportion of carbohydrates and fat, as compared to protein, has a "narrow" ratio. While these terms are relative, it may be said that a ratio greater than 1 : 6 is wide, while one less than 1 : 5 is narrow. The composition of feeding stuffs, that is, the proportion in which the different nutrients occur, is determined by chemical analysis, but the amount of each nutrient that is actually digestible has been determined by careful experiments with living animals. Only the digestible nutrients are considered in the tables given in this publication.

In Table I, under the title of "Feeding Standards," are given the approximate requirements of various classes of animals and under varying conditions.

FEEDING STANDARDS

The feeding standards prepared by Wolff, a German investigator in animal nutrition, have been the most widely used of any. These were based largely on the weight of the animal, although an attempt was made to

make allowance for the age of the animal and for the kind of work performed. Of late, however, there has been a quite general belief that the standards should take more account of the amount or character of production. In the case of milch cows, for example, it is thought that the standard should be adapted to the amount of milk produced, making the live weight a matter of secondary consideration. The most important use of protein in feeding cows is in the formation of milk. Hence a cow producing 20 quarts of milk a day will require considerably more protein to elaborate this milk than one giving only 8 quarts; and as the milk production of cows bears no particular relation to the live weight, a hundred pounds in weight more or less need make very little difference in the ration. The use of rations varying in accordance with the milk production is comparatively simple, as it only requires that the weight of milk given by different cows shall be known. Wolff's standards have recently been modified by Professor F. Lehmann, as the result of additional experiments and practical experience, and also in the attempt to adapt them more closely to the practical needs of the animal. These standards are as follows:—

TABLE I

WOLFF-LEHMANN FEEDING STANDARDS

[Showing amounts of nutrients per 1000 pounds live weight for a day's feeding.]

ANIMAL	TOTAL DRY MATTER	DIGESTIBLE NUTRIENTS		
		Protein	Carbohy- drates	Fat
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Oxen:				
At rest in stall	18	0.7	8.0	0.1
At light work	22	1.4	10.0	0.3
At medium work	25	2.0	11.5	0.5
At heavy work	28	2.8	13.0	0.8
Fattening cattle:				
First period	30	2.5	15.0	0.5
Second period	30	3.0	14.5	0.7
Third period	26	2.7	15.0	0.7
Milch cows:				
Giving 11 pounds milk a day . .	25	1.6	10.0	0.3
Giving 16½ pounds milk a day . .	27	2.0	11.0	0.4
Giving 22 pounds milk a day . .	29	2.5	13.0	0.5
Giving 27½ pounds milk a day . .	32	3.3	13.0	0.8
Sheep:				
Coarse wool	20	1.2	10.5	0.2
Fine wool	23	1.5	12.0	0.3
Breeding ewes, with lambs . . .	25	2.9	15.0	0.5
Fattening sheep:				
First period	30	3.0	15.0	0.5
Second period	28	3.5	14.5	0.6
Horses:				
Light work	20	1.5	9.5	0.4
Medium work	24	2.0	11.0	0.6
Heavy work	26	2.5	13.3	0.8
Brood sows	22	2.5	15.5	0.4
Fattening swine:				
First period	36	4.5	25.0	0.7
Second period	32	4.0	24.0	0.5
Third period	25	2.7	18.0	0.4

ANIMAL	TOTAL DRY MATTER	DIGESTIBLE NUTRIENTS		
		Protein	Carbohy- drates	Fat
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Growing cattle:				
Dairy breeds —				
2 to 3 months old, weighing about 150 pounds	23	4.0	13.0	2.0
3 to 6 months old, weighing about 300 pounds	24	3.0	12.8	1.0
6 to 12 months old, weighing about 500 pounds	27	2.0	12.5	0.5
12 to 18 months old, weighing about 700 pounds	26	1.8	12.5	0.4
18 to 24 months old, weighing about 900 pounds	26	1.5	12.0	0.3
Beef breeds —				
2 to 3 months old, weighing about 160 pounds	23	4.2	13.0	2.0
3 to 6 months old, weighing about 330 pounds	24	3.5	12.8	1.5
6 to 12 months old, weighing about 550 pounds	25	2.5	13.2	0.7
12 to 18 months old, weighing about 750 pounds	24	2.0	12.5	0.5
18 to 24 months old, weighing about 950 pounds	24	1.8	12.0	0.4
Growing sheep:				
Wool breeds —				
4 to 6 months old, weighing about 60 pounds	25	3.4	15.4	0.7
6 to 8 months old, weighing about 75 pounds	25	2.8	13.8	0.6
8 to 11 months old, weighing about 80 pounds	23	2.1	11.5	0.5
11 to 15 months old, weighing about 90 pounds	22	1.8	11.2	0.4
15 to 20 months old, weighing about 100 pounds	22	1.5	10.8	0.3
Mutton breeds —				
4 to 6 months old, weighing about 60 pounds	26	4.4	15.5	0.9
6 to 8 months old, weighing about 80 pounds	26	3.5	15.0	0.7

ANIMAL	TOTAL DRY MATTER	DIGESTIBLE NUTRIENTS		
		Protein	Carbohy- drates	Fat
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Growing sheep:				
8 to 11 months old, weighing about 100 pounds	24	3.0	14.3	0.5
11 to 15 months old, weighing about 120 pounds	23	2.2	12.6	0.5
15 to 20 months old, weighing about 150 pounds	22	2.0	12.0	0.4
Growing swine:				
Breeding stock —				
2 to 3 months old, weighing about 50 pounds	44	7.6	28.0	1.0
3 to 5 months old, weighing about 100 pounds	35	5.0	23.1	0.8
5 to 6 months old, weighing about 120 pounds	32	3.7	21.3	0.4
6 to 8 months old, weighing about 200 pounds	28	2.8	18.7	0.3
8 to 12 months old, weighing about 250 pounds	25	2.1	15.3	0.2
Growing fattening swine:				
2 to 3 months old, weighing about 50 pounds	44	7.6	28.0	1.0
3 to 5 months old, weighing about 100 pounds	35	5.0	23.1	0.8
5 to 6 months old, weighing about 150 pounds	33	4.3	22.3	0.6
6 to 8 months old, weighing about 200 pounds	30	3.6	20.5	0.4
9 to 12 months old, weighing about 275 pounds	26	3.0	18.3	0.3

In Table II is given a list of the feeding stuffs in most common use by the American farmer, and calculations have been made of the amounts of digestible protein, fat, and carbohydrates contained in 100 pounds of each.

In making these calculations, the analyses and digestion coefficients, as found by American experiments, were used

as far as possible, because these are the figures which the American farmer has to consult in selecting his feeding stuffs and making up a ration.

TABLE II

DRY MATTER AND DIGESTIBLE FOOD INGREDIENTS IN 100 POUNDS OF FEEDING STUFFS

FEEDING STUFF	TOTAL DRY MATTER	PROTEIN	CARBOHY- DRATES	FAT
	Pounds	Pounds	Pounds	Pounds
Green fodder:				
Corn fodder ¹ (average of all varieties)	20.7	1.10	12.08	0.37
Kafir-corn fodder	27.0	0.87	13.80	0.43
Rye fodder	23.4	2.05	14.11	0.44
Oat fodder	37.8	2.44	17.99	0.97
Redtop, in bloom	34.7	2.06	21.24	0.58
Orchard grass, in bloom	27.0	1.91	15.91	0.58
Meadow fescue, in bloom	30.1	1.49	16.78	0.42
Timothy, ² at different stages	38.4	2.01	21.22	0.64
Kentucky blue grass	34.9	2.66	17.78	0.69
Hungarian grass	28.9	1.92	15.63	0.36
Red clover, at different stages	29.2	3.07	14.82	0.69
Crimson clover	19.3	2.16	9.31	0.44
Alfalfa, ³ at different stages	28.2	3.89	11.20	0.41
Cowpea	16.4	1.68	8.08	0.25
Soy bean	28.5	2.79	11.82	0.63
Rape	14.3	2.16	8.65	0.32
Corn silage (recent analyses)	25.6	1.21	14.56	0.88
Corn fodder, ¹ field cured	57.8	2.34	32.34	1.15
Corn stover, field cured	59.5	1.98	33.16	0.57
Kafir-corn stover, field cured	80.8	1.82	41.42	0.98
Hay from —				
Barley	89.4	5.11	35.94	1.55
Oats	84.0	4.07	33.35	1.67
Orchard grass	90.1	4.78	41.99	1.40
Redtop	91.1	4.82	46.83	0.95
Timothy ² (all analyses)	86.8	2.89	43.72	1.43

¹ Corn fodder is entire plant, usually sown thick.

² Herd's grass of New England and New York.

³ Lucern.

FEEDING STUFF	TOTAL DRY MATTER	PROTEIN	CARBOHY- DRATES	FAT
	Pounds	Pounds	Pounds	Pounds
Orchard grass				
Kentucky blue grass	78.8	4.76	37.46	1.99
Hungarian grass	92.3	4.50	51.67	1.34
Meadow fescue	80.0	4.20	43.34	1.73
Mixed grasses	87.1	4.22	43.26	1.33
Rowen (mixed)	83.4	7.19	41.20	1.43
Mixed grasses and clover . . .	87.1	6.16	42.71	1.46
Red clover	84.7	7.38	38.15	1.81
Alsike clover	90.3	8.15	41.70	1.36
White clover	90.3	11.46	41.82	1.48
Crimson clover	91.4	10.49	38.13	1.29
Alfalfa ¹	91.6	10.58	37.33	1.38
Cowpea	89.3	10.79	38.40	1.51
Soy bean	88.7	10.78	38.72	1.54
Wheat straw	90.4	0.37	36.30	0.40
Rye straw	92.9	0.63	40.58	0.38
Oat straw	90.8	1.20	38.64	0.76
Soy-bean straw	89.9	2.30	39.98	1.03
Roots and tubers:				
Potatoes	21.1	1.36	16.43	—
Beets	13.0	1.21	8.84	0.05
Mangel wurzels	9.1	1.03	5.65	0.11
Turnips	9.5	0.81	6.46	0.11
Rutabagas	11.4	0.88	7.74	0.11
Carrots	11.4	0.81	7.83	0.22
Grains and other seeds:				
Corn (average of dent and flint) .	81.1	7.14	66.12	4.97
Kafir corn	87.5	5.78	53.58	1.33
Barley	89.1	8.69	64.83	1.60
Oats	89.0	9.25	48.34	4.18
Rye	88.4	9.12	69.73	1.36
Wheat (all varieties)	89.5	10.23	69.21	1.68
Cotton seed (whole)	89.7	11.08	33.13	18.44
Mill products:				
Corn meal	85.0	6.26	65.26	3.50
Corn-and-cob meal	84.9	4.76	60.06	2.94
Oatmeal	92.1	4.53	52.06	5.93
Barley meal	88.1	7.36	62.88	1.96
Ground corn and oats, equal parts	88.1	7.01	61.20	3.87
Pea meal	89.5	16.77	51.78	0.65

FEEDING STUFF	TOTAL DRY MATTER	PROTEIN	CARBOHY- DRATES	FAT
	Pounds	Pounds	Pounds	Pounds
Waste products:				
Gluten meal —				
Buffalo	91.8	21.56	43.02	11.87
Chicago	90.5	33.09	39.96	4.75
Hammond	91.9	24.90	45.72	10.16
King	92.8	30.10	35.10	15.67
Cream gluten (recent analyses) .	90.4	30.45	45.36	2.47
Gluten feed (recent analyses) . .	91.9	19.95	54.22	5.35
Buffalo (recent analyses) . .	91.0	22.88	51.71	2.89
Rockford (Diamond)	91.3	20.38	54.71	3.82
Hominy chops	88.9	8.43	61.01	7.06
Malt sprouts	89.8	18.72	43.50	1.16
Brewers' grains (wet)	24.3	4.00	9.37	1.38
Brewers' grains (dried)	92.0	19.04	31.79	6.03
Distillery grains (dried, princi- pally corn)	93.0	21.93	38.09	10.83
Distillery grains (dried, princi- pally rye)	93.2	10.38	42.48	6.38
Atlas gluten feed (distillery by- product)	92.6	23.33	35.64	11.88
Rye bran	88.2	11.47	52.40	1.79
Wheat bran, all analyses	88.5	12.01	41.23	2.87
Wheat middlings	84.0	12.79	53.15	3.40
Wheat shorts	88.2	12.22	49.98	3.83
Buckwheat bran	88.5	19.29	31.65	4.56
Buckwheat middlings	88.2	22.34	36.14	6.21
Cotton-seed feed	92.0	9.65	38.57	3.37
Cotton-seed meal	91.8	37.01	16.52	12.58
Cotton-seed hulls	88.9	1.05	32.21	1.89
Linseed meal (old process)	90.8	28.76	32.81	7.06
Linseed meal (new process) . . .	90.1	30.59	38.72	2.90
Sugar-beet pulp (fresh)	10.1	0.63	7.12	—
Sugar-beet pulp (dry)	93.6	6.80	65.49	—
Milk and its by-products:				
Whole milk	12.8	3.38	4.80	3.70
Skim milk, cream raised by setting	9.6	3.10	4.61	0.90
Skim milk, cream raised by separator	9.4	3.01	5.10	0.30
Buttermilk	9.0	2.82	4.70	0.50
Whey	6.2	0.56	5.00	0.10

Assume now that the farm is supplied with good red clover, hay, corn silage, buckwheat middlings, and that gluten feed can be procured as cheaply as any feed on the market; and that dairy cows are to be fed, each giving at least 20 pounds of milk per day, and weighing an average of 1000 pounds each. Such cows should receive approximately 25 pounds of dry matter per day each, and the ratio should be 1 ; 5, 4. Turning to the table, it will be seen that a proper ration can be compounded as follows:—

- 20 pounds red clover hay.
- 20 pounds corn silage.
- 2 pounds buckwheat middlings.
- 2 pounds gluten feed.

And applying the rule, the ration would read as follows:—

	TOTAL DRY MATTER	PROTEIN	CARBOHY- DRATES AND FAT
20 lb. clover	16.94	1.476	8.444
20 lb. corn silage	5.12	.242	3.308
2 lb. buckwheat middlings	1.764	.4468	1.002
2 lb. gluten feed	1.838	.399	1.325
	25.662	2.5638	14.079

Ratio, 1; 5, 4.

Again, suppose the farmer has no silo and consequently no silage, as is often the case, but has a mow of good clover hay; he raises some good field corn and oats, and can purchase cotton-seed meal at a reasonable price; how shall he mix his ration so as to obtain the best possible results

for the least money? A little study of the foregoing tables will determine his feed ration:—

	TOTAL DRY MATTER	PROTEIN	CARBOHY- DRATES AND FAT
20 lb. clover	16.94	1.476	8.444
4 lb. corn-and-cob meal	3.396	.190	2.667
3 lb. ground oats	2.763	.135	1.962
2 lb. cotton-seed meal	1.836	.740	.896
	24.935	2.541	13.969

The foregoing ration is about what should be fed to a cow weighing about 1000 pounds and giving 20 pounds of milk per day. If she is giving more milk, feed more of the ration; if she is giving less, feed less.

In compounding a ration it is generally desirable to mix a considerable quantity at a time, and this work should be thoroughly done; otherwise unsatisfactory results will follow.

The trouble with most of the balanced rations is that they cost too much, and at the present prices of grain and milk products the margin of profit is too small. It seems to be a very general practice throughout the country for the dairy farmer to turn over his milk checks at the end of the month to the feed man.

This should not be, and need not be, if a more rational method of feeding is employed. The ordinary dairyman cannot afford to buy Western grain for the purpose of manufacturing it into Eastern milk. He must learn to produce his own raw material on his own farm. How shall he do this? Laying aside all prejudice in the matter, and relying wholly upon the facts as established by the

experience of hundreds of the most successful feeders in the country, the writer undertakes to say that there is no roughage produced upon the farm so cheaply, so healthful, and so valuable for milk production as good corn silage, and that every farmer who produces milk for any purpose cannot afford to be without a good silo.

Every farmer could also, without much additional labor, grow three or four acres of mangel-wurzel beets. Most farmers grow clover or alfalfa, and some of them a little grain. Now, referring to the table, it will be seen that the best possible balanced ration can be provided from material grown wholly upon the farm, and it will be found superior to the purchased ration for both health and milk production:—

	DRY MATTER	PROTEIN	CARBOHY- DRATES AND FAT
20 lb. clover	16.94	1.476	8.444
30 lb. corn silage	7.68	.363	5.962
30 lb. mangel beets	2.73	.309	1.769
2 lb. buckwheat middlings	1.764	.446	1.002
	29.114	2.594	16.177

For all practical purposes this is a balanced ration, is entirely homemade, and will prove in every way satisfactory.

It is proper here to state that almost every animal upon the farm is benefited by a regular feed of silage and roots, and no cheaper ration can be furnished.

FEEDING THE HORSE

In feeding his horses the farmer shows less judgment and discretion than in feeding any other farm animal. He will cheerfully supply a varied ration for his cows in the form of clover, ensilage, roots, and various grains; he will feed his sheep, his swine, and even his poultry on such variety of foods as he may have or be able to procure; but he insists on feeding his horses on timothy hay and oats straight, three times a day, for 365 days each year, as long as the animal lives. It is difficult to understand how such a system of feeding could ever have become general. It is not based on common sense; it is wasteful and cruel.

A little reflection should convince any one that the horse, in common with every other domestic animal, requires and enjoys variety in his feeding. Indeed, no other farm animal is so discriminating in his tastes and so thoroughly enjoys palatable foods as the horse. He appreciates the lump of sugar and the sweet apple to a degree not equaled by any other animal on the farm, and yet he is condemned for life to subsist on a single, monotonous, changeless ration. Timothy hay and oats may be a good ration if used with judgment and in combination with other foods, but alone such a ration falls very far short of supplying the necessary bodily requirements.

A little reflection on the part of the farmer will recall the fact that none of his animals are ever troubled with colic excepting the horse; that indigestion, worms, and other disorders of the intestines are not generally troublesome except among his horses. Yet it has never occurred

to him that his changeless ration of hay and oats is the cause of most of the trouble.

The horse requires a balanced ration just as surely as any other animal, compounded with reference to his size and the kind of work he is required to do, and this ration should be varied as much and as often as possible. A very satisfactory ration for work horses — satisfactory because they not only enjoy it but actually fatten upon it — is 20 pounds of good corn silage, 15 pounds corn-and-cob meal, 2 pounds bran, and 1 pound cotton-seed meal, divided into three feeds and fed fresh, the grain being sprinkled upon the silage. The quantity should, of course, be varied according to the size of the animal and the character of work performed. This ration may be varied by substituting cut beets for the corn silage and the addition of a small quantity of good clover or alfalfa hay.

There is an erroneous belief among horsemen and farmers that the feeding of clover and alfalfa hay is injurious to horses, and that it causes "heaves" in the animal. There is no scientific basis for such belief, and the experience of the writer in feeding such hay to horses for many years convinces him that there is absolutely no foundation in fact for such belief. The feeding value of clover or alfalfa is several times greater than that of timothy hay; hence, much smaller quantities should be fed.

As showing not only the value, but also the economy of feeding horses a varied ration, such as carrots or other succulent food, it may be stated that very careful experiments have proven that carrots and ground oats fed

together in equal quantities give equally good results, bushel for bushel, as when oats only are fed. In other words, half a bushel of ground oats mixed with half a bushel of carrots gave better results than a whole bushel of oats, and the cost of the ration was reduced by one third. Horses enjoy a feed of cracked corn and whole oats, and a hot bran mash on Saturday night is beneficial.

Never deny the horse a daily feed of fresh grass as soon as it is possible to procure it in the spring, and if he can be given a little vacation in the pasture, the beneficial results will be at once apparent. "Old Dr. Grass" is the greatest veterinarian in the world, and he is indeed a shortsighted farmer who will not employ him when he is passing by the door in the springtime, offering to work his wonders free of charge.

FEED MANGERS AND RACKS

As a rule, feed mangers and racks are an abomination. The mangers are usually half filled with dust, chaff, dirt, and sour feed, while the racks serve only as a means of sifting the dirt, seeds, dust, and chaff into the eyes, ears, and hair of the horse. The good farmer will employ neither.

The stall should be supplied with a good floor and plenty of bedding, and the hay should be placed upon the floor in front of the horse in such quantities as he needs, not in such quantities as he will eat. Nature intended the horse to eat from the ground at the level of his feet; hence, the floor of his stall and not a rack high above his head is the proper place for his hay. His feed box should be placed in the corner, well out of the way, and must al-



GLADIATOR.

A three-year-old Percheron stallion, weighing 1700 lbs. The result of good breeding and feeding.

Owned by the New York State School of Agriculture, Alfred, N. Y.

ways be kept clean. Water should be pure and fresh and frequently given. His bed should be clean and plentiful. He should be provided with sunlight, good ventilation, and a warm stable. In short, he should be fed, cared for, and treated with common sense, and he will repay such attention with many years of faithful service.

CHAPTER XXI

THE DAIRY HERD

ITS FORMATION AND MANAGEMENT

THERE are two important factors entering into successful dairy farming, viz. the man and the herd.

The owner or caretaker of a herd of dairy cows must have a natural fondness for animals and especially for the dairy cow, while the cattle must be good of their kind, strictly dairy animals, and of the variety best adapted to the conditions and requirements.

Dairying, like almost all other occupations, has become divided and specialized into several distinct lines, differing mainly as to the form of product and manner of disposal. The product may be worked up into butter at home, or the whole milk may be delivered to the creamery or cheese factory. Or the cream only may be delivered to the creamery or sold to private consumers. Or the milk may be supplied to customers every morning, fresh from the dairy. Local conditions and markets will determine which line can be most advantageously pursued, and the requirements of customers will aid in selecting the breed of dairy cows best adapted to a dairyman's use.

It is not the purpose of the writer to enter the lists for the never-ended "battle of the breeds." Every dairyman can determine for himself the kind of animals he

should adopt, if he will acquaint himself somewhat with the prominent characteristics of the various breeds and make a careful study of his surrounding conditions.

FORMATION OF THE HERD

There are two practical ways of building up a dairy herd. First, secure a few well-selected grade cows of the breed decided upon and a first-class, pure-bred bull. Raise only the heifer calves from the very best cows, disposing of the bull calves at once, as well as the heifer calves from inferior cows. When the heifers that are kept arrive at maturity, serve them with another pure-bred bull of the same breed, and so continue the process of selection until the fifth generation, when the whole herd will be practically thoroughbred.

CHOICE OF BULLS

There is a trite saying among breeders that "the bull is half the herd." This is literally true with pure-bred stock, and in grading up a herd he is much more than half. The prepotency of the thoroughbred is so strong that from the first cross he will influence the conformation, color, and temperament of the calves and implant within them the characteristics of the breed which he represents, and if he himself is a good individual, with good pedigree, and is backed by good milk records, the farmer may hope for final success.

WHAT USUALLY HAPPENS

After a few crosses of this kind the dairyman begins to see the benefit of breeding up to the thoroughbred, and he is also made aware of the demand for pure-bred stock

which he is not able to supply. He then purchases a cow or two of registered stock to mate with his registered bull. He joins the association and becomes a breeder of thoroughbreds.

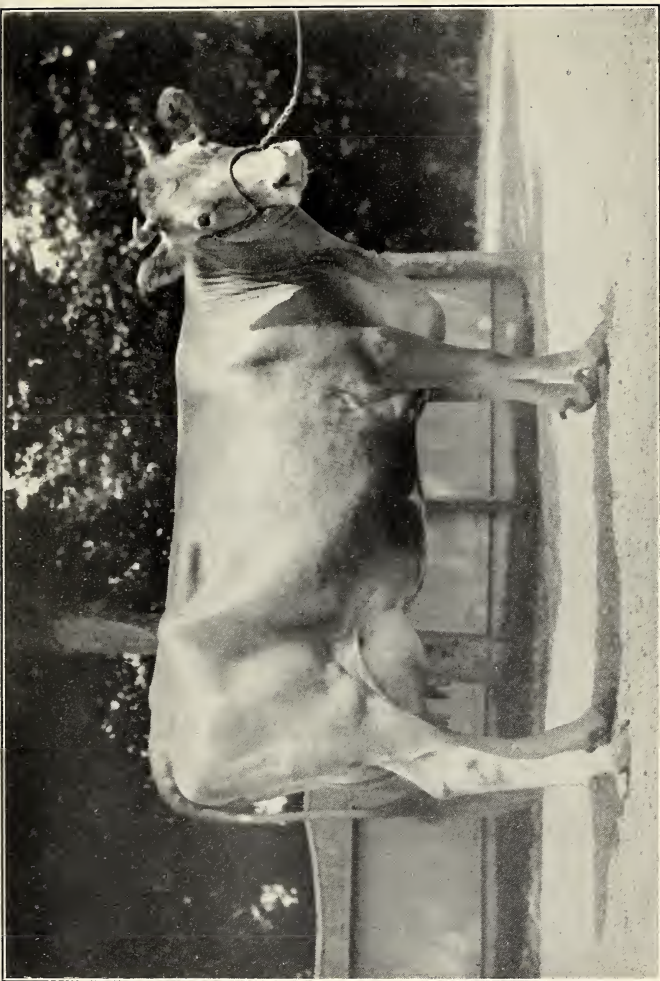
The second way to build up a herd is to go into the market and purchase such a number of thoroughbreds of such character as his bank account will warrant, and start at the top. This should be done only when the dairyman has made himself thoroughly familiar with the pedigrees, records, and characteristics of the breed and is a good judge of the dairy cow.

It should not be forgotten that there are many worthless cows among the thoroughbreds as well as among the grades, and that the novice is made the dumping-ground for the disposal of many such animals.

After some experience in breeding the thoroughbred cow, the writer is justified in giving this advice: Buy the best cow you can afford, for in this case, at least, the best is the cheapest. If you have \$300, put it all into one first-class cow, and not into three merely fair cows, for the first-class cow is worth three times as much as the other. Her calves will sell for three times as much, and a dairy bred from her will be worth three times as much as a dairy bred from just fair cows. Her possession gives pride to the dairyman and prestige to the dairy. The beginner should purchase his first registered animals from some breeder of known integrity and good standing in the business.

THE BULL

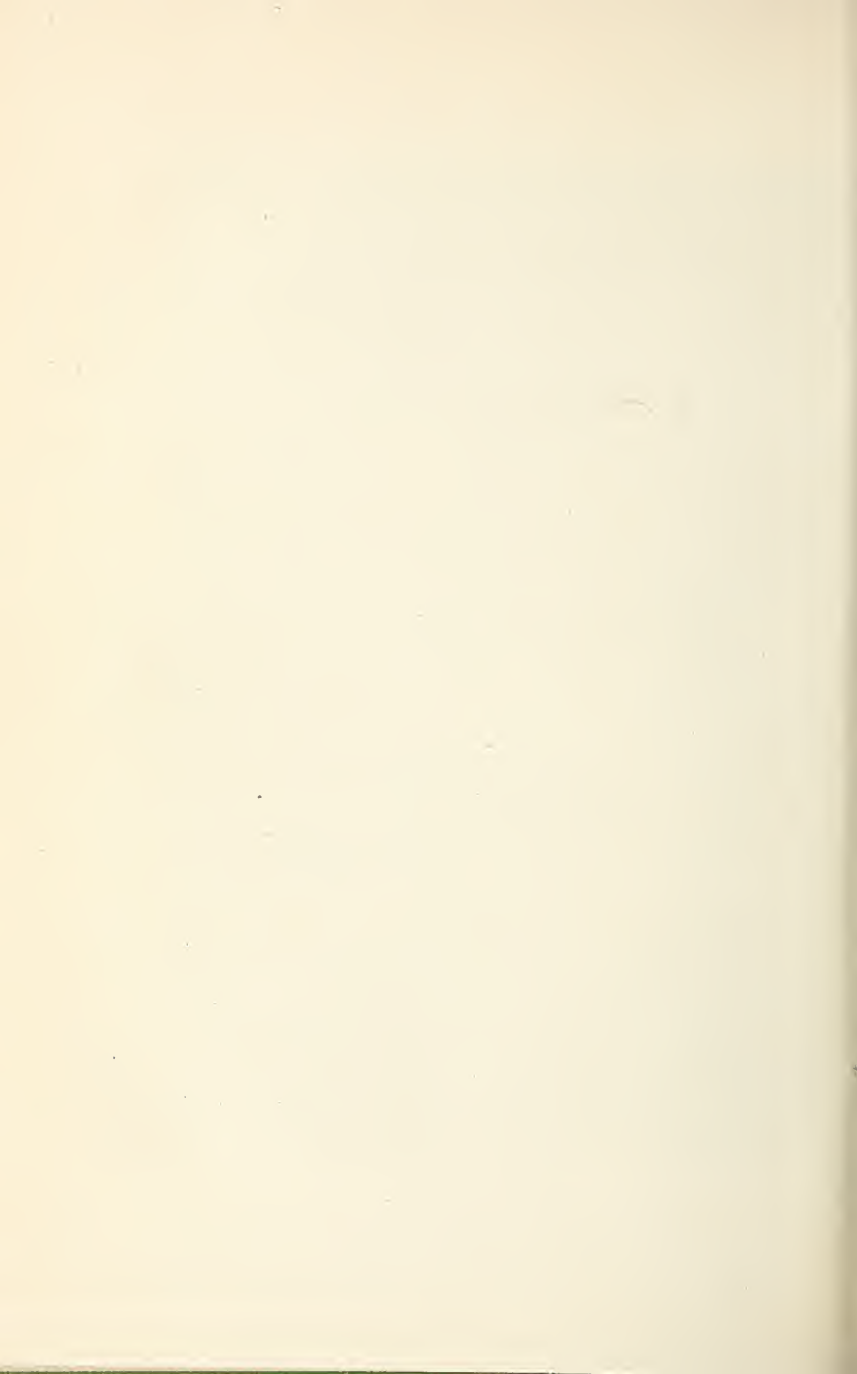
Enough has been said to show the necessity of procuring the best bull within reach of the beginner. The best is



MISSY OF THE GLEN.

Record Guernsey cow of the world. Milk, 14,591.70 lbs.; butter, 1100 lbs. in one year.

By courtesy of H. A. C. Taylor, Newport, R.I.



none too good and, as before stated, the best is the cheapest. A good individual of good pedigree, backed by good records, is the most valuable asset any breeder can possess. Such a bull should be kept as long as he remains potent, and the more closely the whole herd is related to him (without in-breeding) the better.

TREATMENT OF THE BULL

Without doubt bulls are generally improperly treated, with the result that they frequently become vicious. The fully developed bull cannot be allowed to run with the dairy for various reasons; neither should he be wholly isolated from the herd. He should be stabled where he can have the company of the cows, and should be regularly cleaned, fed, and cared for. More important still, he should have plenty of exercise, for nothing tends to spoil the temper of a bull so much as enforced idleness, while nothing so surely promotes docility as plenty of work. A tread power set up in the stable or adjoining building is not only the best and easiest way to give a bull plenty of exercise, but in this way he can be made to perform much useful labor, such as separating cream and milk, cutting hay, straw and roots, pumping water, shelling corn, grinding, and many other necessary things that are usually performed by hand. He should, of course, always be handled with staff and ring.

CULLING THE HERD

At least 25 per cent of all the dairy cows in this country are kept at a loss, while quite as many more fail to produce a profit at the end of the year. In other words, only one half of our dairy cows should be retained. There is no

excuse for keeping cows which fail to give their owner a profit, and the sooner they are weeded out and disposed of the better. The plan hereafter described, of testing milk and keeping individual records, will enable the dairyman to select the good cows and dispose of the poor ones; until this is done, the business will not pay.

STABLING THE HERD

The fodder and the dairy should not occupy the same building. However well constructed such a building may be, it will not give the best results. Under such conditions it will be impossible to keep the stable free from dust, or to prevent escaping odors from tainting the fodder. Sleeping, living, and storing food in the same room is undoubtedly bad practice for man or beast.

The cow stable should not occupy a basement, but should be wholly above ground and supplied with plenty of double windows, so that every part of the interior may be flooded with sunlight during some part of the day. There is no known exterminator of germs equal to sunlight, and it is absolutely necessary for the health of the dairy and the production of good milk. It costs nothing, and therefore every stable should be so constructed as to secure the largest possible benefit from sunshine.

VENTILATION

Fresh air is quite as important in the dairy as sunshine, and various systems have, from time to time, been advocated, tried, modified, and adopted or discarded. Some of these, involving large expense, will work successfully in one location and utterly fail in another, while very few

give entire satisfaction. After some years of experience and considerable outlay, the writer inclines to the belief that the cheapest and best way to ventilate the stable is to replace window glass with muslin cloth in such a number of windows as will admit the required fresh air. It is quite surprising how efficient such an arrangement proves to be, and the cost is almost nothing in comparison with any other plan.

INTERIOR ARRANGEMENTS

The construction of floors, mangers, gutters, and ties is as variable as the whims of various owners, and is largely a matter of personal choice; but three results should be secured, viz. comfort, convenience, and cleanliness. Generally it is better to leave the feeding space in front entirely open and unencumbered with manger or feed boxes, so that it can be swept clean at least twice a day, leaving no corners or cracks where sour feed and dirt can accumulate.

WATERING

Much attention has been given to the question of watering stock in the stable, with the result that expensive systems of plumbing have sometimes been installed, all of which are more or less open to objection. Like the matter of ventilation, progressive dairymen are going back to the simplest and least expensive way, and find it as a rule the best.

All stock require some exercise every day and should be let out at some time for that purpose; if a trough of good water is provided in the yard, every requirement demanded for exercise and water service will be met.

CHAPTER XXII

TESTING MILK AND CREAM

EVERY dairyman should know exactly, not only what his dairy is producing from day to day and from month to month, but also what each animal in the dairy is bringing to him in return for the feed and care bestowed. It is quite impossible to know which are the profitable and which the unprofitable cows in the dairy until it is determined what quantity of butter fat they are producing. Many cows giving large quantities of milk are really poor cows to keep, because of the low percentage of butter fat contained in their milk; while other cows, giving a much smaller quantity of milk, are profitable because of the high per cent of butter fat contained in their milk.

Whether the milk is disposed of to the creamery or is manufactured into butter at home, the quantity of butter produced by any given cow is the factor which determines her value. To illustrate: Suppose Clothilde is the big milker of the dairy, and produces 50 pounds per day. Now, Jennie is a little cow producing 30 pounds, and is considered of small account. But a test of the milk may reveal the fact that Jennie is much more valuable than Clothilde. A test often shows results like the following:—

DAILY YIELD	PER CENT OF FAT	TOTAL FAT	TOTAL BUTTER
Clothilde, 50 lbs.	2.5	1.25	1.562
Jennie, 30 lbs.	5.5	1.65	2.062

It will be readily seen that Jennie produces $\frac{1}{2}$ more butter each day than Clothilde, $3\frac{1}{2}$ pounds more in a week, 15 pounds more in a month, and 182 more pounds in a year. If butter is sold for 25 cents a pound, the yearly return of Jennie over Clothilde is \$45.50, and this may mean just the difference between a profitable and an unprofitable cow.

If the product of the dairy is sold to the creamery or the condensory, the basis upon which payment is usually made is the content of fat, in which case the dairyman should know positively that he is receiving honest payment for the value of his milk. In whatever manner the product of the dairy is to be disposed of, the most ordinary rules of business would require that the dairyman should keep a record of every cow's milk and the percentage of fat which she produces.

The weighing should be done immediately after milking each cow, and the result entered upon the record sheet, which should be kept in some convenient place in the stable or dairy house. Without the exact weight of the milk, the test would be of no value, while, at the same time, the weight of the milk is of little value unless the percentage of fat which it contains is determined by actual test. The practice of weighing each cow's milk has the additional advantage of showing the results of various feeds and other

conditions, — all important for the dairyman to know if he expects to secure the best results.



A spring-balance scale.

A spring-balance scale should be hung in some convenient place, of the kind commonly used in making the Babcock test, for keeping milk and butter records. This scale is provided with a loose pointer, which, by means of a thumbscrew, may be set at any point on the dial to offset the weight of the pail, so that this does not have to be deducted from the reading. The reading being in pounds and tenths of pounds, the calculation is much simpler than if pounds and ounces were given, as on an ordinary scale. Such a scale, capable of weighing 60 pounds, can be procured for \$3.50.

THE RECORD SHEET

On the wall near the scale should be placed a ruled sheet of strong paper, in the left-hand column of which should be placed the name or number of each cow, corresponding to the order in which they stand in the stable. At the top, and extending across the entire sheet, should be marked the days of the month, as March 1, 2, 3, 4, 5, etc. The sheet of paper should be about 20×30 inches, and should have space enough at the right of all of the columns for insertion of totals for the month, of both the quantity of milk and of butter fat. It is also convenient to place upon the sheet the date of freshening and date of service of each cow. With such a sheet a complete record of the herd will always be accessible.

SAMPLE OF SHEET FOR MARCH

1909

Cow	1
Cow	2
Cow	3
Cow	4
Cow	5
Cow	6
Cow	7
Cow	8

[illegible][illegible]

HOW TO MAKE THE TEST

To properly make the test, the milk, as drawn from each cow, should be thoroughly mixed by pouring it from one pail to another several times. Then a small quantity of the milk should be put into a jar or bottle and placed where it will keep sweet. If it is desired to test the milk given during an entire day, the milk at each milking should be treated in a similar manner and samples of each cow's milk should be secured.

When ready to make the test, the two samples from each cow should be thoroughly mixed by pouring from one bottle to another several times. By means of the milk pipette, or measure, graduated to hold 17.6 c.c., this quantity of milk is transferred to a special bottle having a long and very slender neck, on which are graduations, or per cent marks, from 0 to 10. The capacity of the bottle is a little more than one ounce, and the cubic capacity of the neck from 0 to 10 is exactly 2 c.c. This is the volume of 1.8 grams of fat, which is the substance to be measured on the scale.

As the bottle is so graduated that 1.8 grams represent 10 per cent, it is necessary to use a sample weighing ten times as much, or 18 grams, and the 17.6 c.c. pipette will deliver practically this weight of milk. To the milk is then added 17.5 c.c. of concentrated commercial sulphuric acid having a specific gravity of 1.82. The acid and milk are then mixed by an easy rotary motion while held in the hand, and all of the milk constituents will be dissolved excepting the fat globules. The whole mass will assume a dark brown color and generate considerable heat. The



UPLAND LAURA.

A beautiful Brown Swiss cow.
F. R. Hazard, owner, Syracuse, N. Y.



sample is then placed in a centrifugal machine made for that purpose and whirled at a high speed for five minutes. Hot water is then added in sufficient quantity to bring the fat up to the base of the neck. It is then placed in the machine and whirled for two minutes. More hot water is then added until the fat is brought opposite the graduations in the neck. It is then whirled one minute, so that all the fat possible may be forced into the neck, where the reading or percentages should be quickly taken. The correct reading can only be taken while the fat is warm, as the fat globules rapidly contract as they become cold, and the whole volume will shrink, sometimes to the extent of several marks on the graduated neck of the bottle. The test should be performed in a warm, light room, with convenient hot water.

READING THE TEST

To read the percentage of fat, hold the bottle up to a level with the eye, and read the graduations at each end of the column of fat. Each small division represents two tenths of 1 per cent, and the larger spaces numbered 1, 2, 3, etc., represent 1 per cent of fat. By subtracting the sum of the graduations above and below the column of fat from 10, the correct reading will be obtained. Thus, if the top of the column stands at 7.4 and the bottom at 2.6, the reading will be $2.6 + 2.6 = 5.2$. This subtracted from 10 equals 4.8, which is the correct reading.

Or the same result may be obtained by simply subtracting the figure at the bottom of the column from the figure at the top, thus: $7.4 - 2.6 = 4.8$, which means that in 100 pounds of milk there are 4.8 pounds of fat.

HOW TO COMPUTE THE YIELD OF BUTTER

It is obvious that the space occupied by the pure fat is much less, and consequently the percentage is considerably smaller than would be the case if it was in the form of butter actually churned. It is quite impossible to extract from butter all of the liquids, casein, and various other constituents of the milk, all of which add volume and weight. It has, therefore, become common practice to add to the quantity of fat a certain percentage which will more nearly represent the yield of butter as found by actual practice through churning. The percentage so added is not uniform, and varies from 15 to 20 per cent, depending upon the dealer, creamery, or other purchaser.

It is evident that it is very important for the farmer to know what percentage is being added by the purchaser of his milk; it is also important that he should know what percentage to add when computing the results of his tests in his own dairy.

Stated in another form, the fat which appears as a result of the Babcock test is only 80 or 85 per cent of the amount of butter which would be obtained from the same quantity of milk if it were churned. Taking, then, as a basis, 80 per cent, and the reading of the fat in the test just described, which was 4.8 pounds in each 100 pounds of milk (or 4.80, which means the same thing), we have this result: $4.80 \div .80 = 6$ pounds of butter in 100 pounds of milk.

If the .85 per cent basis is used, the result would be obtained in the same way, viz.: $4.80 \div .85 = 5.647$ pounds of butter in 100 pounds of milk. The mathe-

TABLE FOR COMPUTING THE YIELD OF BUTTER FROM THE PER CENT FAT AS SHOWN BY THE BABCOCK TEST

Test	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00	4.10	4.20	4.30	4.40	4.50	4.60	4.70	4.80	4.90	5.00	5.10	5.20	5.30
Milk lbs.																								
10,000	325	336	348	360	371	383	394	406	418	429	441	452	464	476	487	499	510	522	534	545	557	568	580	592
9000	293	302	313	324	334	345	355	365	376	386	397	407	418	428	438	449	459	470	481	491	501	511	522	533
8000	260	269	278	288	297	306	315	325	334	343	353	362	371	381	390	399	408	418	427	436	446	454	464	474
7000	228	235	244	252	260	268	276	284	293	300	309	316	325	333	341	349	357	365	374	382	390	398	406	414
6000	195	202	209	216	223	230	238	244	251	257	265	271	278	286	292	299	306	313	320	327	334	341	348	355
5000	163	168	174	180	186	192	197	203	209	215	221	226	232	238	244	250	255	261	267	273	279	284	290	296
4000	134	139	144	148	153	158	162	167	172	176	181	186	190	195	200	204	209	214	218	223	227	232	237	242
3000	97.5	101	104	108	111	115	118	122	125	129	132	136	139	143	146	150	153	157	160	164	167	170	174	178
2000	60.5	67.2	69.6	72.0	74.2	76.6	78.8	81.2	83.6	85.8	88.2	90.6	92.8	95.2	97.4	99.8	102	104	107	109	111	114	116	118
1000	32.5	33.6	34.8	36.0	37.1	38.3	39.4	40.6	41.8	43.0	44.1	45.2	46.4	47.6	48.7	49.9	51.0	52.2	53.4	54.5	55.7	56.8	58.0	59.2
900	29.3	30.2	31.3	32.4	33.4	34.5	35.5	36.5	37.6	38.6	39.7	40.7	41.8	42.8	43.8	44.9	45.9	47.0	48.1	49.1	50.1	51.1	52.2	53.3
800	26.0	26.9	27.8	28.8	29.7	30.6	31.5	32.5	33.4	34.3	35.3	36.2	37.1	38.1	39.0	39.9	40.8	41.8	42.7	43.6	44.5	45.4	46.4	47.4
700	22.8	23.5	24.4	25.2	26.0	26.8	27.6	28.4	29.3	30.0	30.9	31.6	32.5	33.3	34.1	34.9	35.7	36.5	37.4	38.2	39.0	39.8	40.6	41.4
600	19.5	20.2	20.9	21.6	22.3	23.0	23.6	24.4	25.1	25.7	26.5	27.1	27.8	28.6	29.2	29.9	30.6	31.3	32.0	32.7	33.4	34.1	34.8	35.5
500	16.3	16.8	17.4	18.0	18.6	19.2	19.7	20.3	20.9	21.5	22.1	22.6	23.2	23.8	24.4	25.0	25.5	26.1	26.7	27.3	27.9	28.4	29.0	29.6
400	13.4	13.9	14.4	14.8	15.3	15.8	16.2	16.7	17.2	17.6	18.1	18.6	19.0	19.5	20.0	20.4	20.9	21.4	21.8	22.3	22.7	23.2	23.7	24.2
300	9.7	10.1	10.4	10.8	11.1	11.5	11.8	12.2	12.5	12.9	13.2	13.6	13.9	14.3	14.6	15.0	15.3	15.7	16.0	16.4	16.7	17.0	17.4	17.8
200	6.5	6.7	6.9	7.2	7.4	7.6	7.9	8.1	8.3	8.6	8.8	9.0	9.3	9.5	9.7	10.0	10.2	10.4	10.7	10.9	11.1	11.4	11.6	11.8
100	3.2	3.4	3.5	3.7	3.8	3.9	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8
90	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3
80	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	
70	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	
60	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	
50	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	
40	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	
30	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	
20	.6	.7	.7	.8	.8	.8	.8	.8	.8	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	
10	.3	.3	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	
9	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	
8	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	
7	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	
6	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	
5	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	
4	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	
3	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	
2	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	
1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	

The above table is based on good creamery practice, using modern apparatus and careful methods, and is a valuable guide for the dairyman or creameryman in estimating the probable yield from his milk; also in comparing or checking results obtained. It is not absolutely correct under all conditions, — no table can be made to cover all conditions. It simply gives average results from good practice.

matal proportion, of course, would be expressed thus:
 $.85 : 100 :: 4.8 : x$.

It is now easy to compute the amount of butter which should be paid for by the creamery when the weight of milk and the percentage of fat are known. It also becomes a simple matter to calculate the quantity of butter produced by any individual cow during a day, week, or month, and the illustration given at the beginning of this chapter in the comparison of Jennie and Clothilde becomes intelligible and applicable.

MAKING OTHER TESTS

When the process of testing milk becomes familiar to the student, farmer, or purchaser of milk, it is a simple matter to learn the method of testing cream, skim milk, buttermilk, or whey. For these purposes full directions are supplied by the manufacturers of any reliable machine. The principles to be applied in every case are the same, and once understood are easy of application to all.

CHAPTER XXIII

FEEDING FOR MILK AND BUTTER RECORDS

It is only within the last half century that the official record as applied to the milk and butter production of individual cows has been practiced, and of more recent date still has the practice become common. At the present time, however, the practice is almost universal among breeders of thoroughbred dairy animals, and is becoming common among dairy farmers in various parts of our own country as well as in many parts of Europe.

The purpose of making the test is twofold, to wit: First, it is bound to eliminate the worthless and unprofitable animals from the herd; and second, it is certain to add financial value to the animal and her offspring if she makes a creditable showing under the test.

THE COW TO TEST

It is quite useless to try to make a record with a cow which does not show evidence of great capacity under normal conditions. Neither is it wise to bother with a cow poor in flesh, not in vigorous health, or imperfect in any respect whatever. Poor records are of no value except to indicate which cows should be disposed of for beef, and good records are possible only when the condition of the cow and all of her surroundings are favorable.

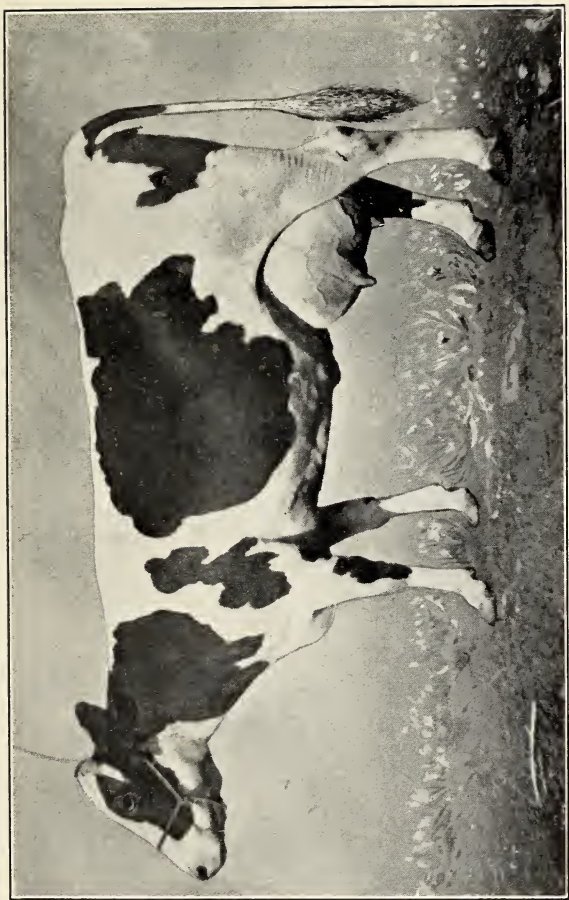
Some most surprising results are obtained from these tests, and it often happens that the breeder himself is the one most astonished at the final results. It has frequently happened that some cow in the herd, little suspected of greatness, and not highly valued, has, under the test, shown such wonderful capacity and made a record of such proportions that her value has leaped into thousands of dollars almost overnight.

To illustrate this point, we will take the Holstein-Frisian cow, Calantha 4ths Johanna. Because of her failure to breed for some time, she was very nearly delivered to the butcher for beef; but she finally succeeded in bringing forth a calf. She was at once put into the test, with the result that she became one of the greatest dairy cows in the world. The official record credits this cow with the enormous production of 27,432.5 pounds of milk in one year, containing an average per cent of 3.64 of fat, equivalent to 1247.82 pounds of butter; and the owner states that he has refused an offer of \$15,000 for the cow.

Another equally wonderful performance is the new world's record made by Grace Fayne 2ds Homestead, a cow of the same breed, in which she produced 35.55 pounds of butter in seven days.

Of course such records are the exception and not the rule; they are made possible only by the most careful and intelligent selection in breeding, patient study of the requirements and habits of the individual cow, scientific feeding, — a perfect cow in perfect condition and under ideal surroundings.

A very significant point is clearly demonstrated in the several tests to which this cow was subjected, to wit:



COLANTHA 4TH'S JOHANNA.

World's champion Holstein butter cow.

Record for 7 days, milk 651.7 lbs.; butter, 35.22 lbs. Record for one year,
milk 27,432.5 lbs.; butter, 1247.82 lbs.

Owned by Wm. J. Gillett, Rosendale, Wis.

that her percentage of fat increased from year to year, showing conclusively that her general health was not impaired by the severe strain imposed by the yearly tests.

HOW TESTS ARE MADE — PREPARATION OF THE COW

There is no doubt that the cow undergoing an official test is subjected to a severe physical strain; but if she is properly prepared for the trial and intelligently handled, there is no serious danger that ill results will follow. In fact, many of the most notable records have been made by cows subjected to the test year after year, and instead of showing signs of weakness they have constantly increased their records.

In preparing a cow for the test, the first thing to do is to give her a rest. She should go dry at least six weeks before she is due to freshen, and two months, or even three, would be better. During this period of rest she should be fed such rations as will not only produce an abundance of fat, but also promote good health. She should be provided with succulent food such as good silage and roots, some fat-producing grains and plenty of bright, fresh clover hay or alfalfa. She should have plenty of exercise and always a clean, warm bed.

As the time approaches when the calf is expected, the ration should be gradually changed to correspond to the ration which is to be fed under the test, and by the time the calf is dropped she should be eating two thirds of the amount which she is capable of consuming.

Her ration should be divided into four equal parts and fed at four equal periods of time during the 24 hours of

each day. For example, at 5 A.M., 11 A.M., 5 P.M., and 11 P.M. Never dope her with salts or other drugs, and do not worry about the cake in her udder. The more it cakes, the more fat will come down when she freshens.

She should be allowed the use of a roomy box stall for a sufficient length of time before freshening to permit her to become familiar with her surroundings. She should not be milked before the calf is dropped. Such a cow will have little trouble in the delivery of her calf, and the calf from such a cow is certain to be a strong, robust animal. Leave them alone together for the first 24 hours. The calf don't need you and the cow is better off without you, except to serve her with food and water.

Nature has so arranged these matters that the milk will be drawn from the cow a little at a time, and frequently, as the calf may require its food; this treatment will not produce "milk fever"; but if the farmer interferes and draws a pailful at once from the distended udder, collapsing every gland, duct, and organ, the old enemy, "milk fever," will be quite likely to follow.

SEPARATING THE COW AND CALF

When the calf is 24 hours old, he should be separated from the dam and placed where she can neither see nor hear him. She should then be fed her regular ration and milked, and the process of feeding and milking should proceed four times a day by the same person and at exactly the same time each day.

The feed ration should now be gradually increased, but only to the extent that it is promptly and cleanly eaten. If any portion of the ration is unconsumed, it

should be immediately swept up and fed to some other animal. The manger should then be cleaned and no other feed given.

When the calf is six days old, the test should commence, and the cow (if a large one) should then be consuming at least 20 pounds of some mixed grain ration, from 30 to 50 pounds of cut beets, and 25 to 30 pounds of good silage, besides some good clover or alfalfa hay per day. The grain may be fed separately or thrown over the cut beets or the silage. The wishes of the cow must determine the best course to follow. The grain ration itself must also be modified or changed to suit the taste of the animal. A mixture which exactly suits one animal will not be eaten by another. All this should be learned while feeding the cow before the calf is born. The whole aim of the feeder should be to induce the cow to eat the largest possible quantity of feed within a given period while the test is progressing, because the cow is simply a machine for the purpose of converting feed into milk, and the greater her capacity, other things being equal, the larger will be her record.

As a general rule, too many cut beets cannot be fed, and the more beets the cow can be induced to eat, the more grain she will consume. The purpose of feeding the beets is not because of the food value which they possess, but because they aid in the assimilation and digestion of the other foods, keep the bowels open, and prevent fever.

The feeder is now under a test as surely as the cow, and if either fail, the test will also fail. He must keep the cow in perfect health, up to her limit in feed consumption, and gradually increasing her milk flow. The slightest

indication of revolt at the feed ration will call for a change, and the feeder must be ready with the substitute which will tempt the lagging appetite anew.

The successful feeder must be a resourceful man, intelligent, observing, kind, and fond of his charge, while the cow must be quiet, strong, of great constitution and vast capacity. With this combination only can great records be made.

WHY MANY COWS FAIL

Many cows can be made to produce a large flow of milk, but fail because the percentage of butter fat is low, while others, giving a high percentage of fat, fail because they lack capacity to consume sufficient food to produce a proper flow of milk. In either case they are unprofitable cows for the dairy.

CHAPTER XXIV

HOW TO FEED CALVES

THERE is probably no farm animal which is the subject of so much neglect and the victim of so much ignorance as the calf. When reared in nature's way by the side of its mother, there is no more pleasing, beautiful, and happy creature; but when separated from the dam, and with the average farmer as wet nurse, he usually becomes the most dejected, scouring, pot-bellied object of pity to be found on the farm. The reasons for this are not difficult to find. Nature has provided a food in his mother's milk which, in its composition and temperature, is exactly suited to the requirements of his delicate stomach. It contains the fats, the proteins, the ash, and all other ingredients which go to make up the bone, hair, muscle, horns, and hoofs in a perfectly balanced ration and in an absolutely sanitary condition.

What happens when the farmer feeds the calf? Tied with a short rope to a dark, filthy corner of a stall, he is fed twice a day at irregular intervals from a filthy, germ-rotted bucket a cold, sour concoction called milk. No animal on the farm would touch it unless driven to it by terrible hunger. He is allowed to gorge himself until a whole pailful is swallowed and his skin is stretched as tight as a drumhead.

Then what happens? The calf scours, the hair grows towards the head, he stops growing — “stunted” — and if he survives, he usually weighs less in the fall than he did in the spring.

THE RIGHT WAY

The calf should be left with his dam for 24 hours after birth, for reasons explained in a previous chapter. He should then be taught to drink, and fed only his mother's milk for the next 10 days. The milk should be fed as soon as drawn, before the temperature has had time to lower. The utensil from which he is fed should be perfectly clean. Three quarts is enough for any calf at one time. His stall should be light, clean, and well bedded.

When the calf is ten days old, he should receive a handful of grain in a clean box, placed upon the wall in such a position that he can easily reach it. This ration should consist of two parts ground oats, two parts bran, one part corn meal, and one part oil meal, and should be given directly after each feeding of milk. This will prevent the habit of “sucking.”

When he is fifteen days old he should be given a handful of fine clover hay, which he will soon learn to eat regularly. At this age he should be chewing the cud and growing well. From this time on, the change from whole milk to skim milk may be made: very little at first, and in gradually increasing quantities until only the skimmed milk is fed. As he grows older he will require more grain and hay, and he should have all he will eat of both.

The milk, when fed, should at all times be at the same temperature as cow's milk, *i.e.* 93°, and if skimmed milk

is plentiful on the farm, the quantity fed may be increased somewhat, so long as the calf does not have the appearance of pot-belly. But if the milk is disposed of in liquid form, it may not be desirable to feed any skimmed milk; in such case, when the calf is three months old, warm water may be added to the milk in gradually increasing quantities until only the water is fed. At this time he should have daily feeds of silage or cut roots.

PLENTY OF GRAIN

If the calf is fed all the grain and hay he will eat clean, three times a day, and is given all the warm water he desires, he will continue to grow, will be sleek, strong, and happy, and at six months of age should be as large as the ordinary yearling reared under the old system.

Such calves make larger, better, and handsomer cows, and it is the surest way to improve the dairy. The calf should not be put on grass until he is well toward a year old. Of course he should always have access to salt.

CHAPTER XXV

VARIOUS BREEDS OF CATTLE

THERE is a tendency among the breeders of the various breeds of cattle, and especially of the dairy types, to exaggerate and enlarge the good qualities of the breed in which they are interested and to belittle the qualities of other breeds. To such an extent does this practice prevail that it is quite impossible to determine the actual facts or learn the exact truth. Doubtless all breeds have their good and their bad points, and all have their places of usefulness, and may occupy some position to which they are best adapted.

It has often occurred to the writer that most of the dairy breeds are entitled to the praise bestowed upon them; that each excels in some particular respect, and that the choice of breeds is largely a matter of individual taste and the purpose for which the product is to be used.

THE HOLSTEIN-FRISIAN CATTLE

This breed of dairy cattle has been bred for 2000 years upon the low, rich lands bordering the eastern shore of the North Sea in Europe. The color is always black and white in irregular spots or patches. In size, constitutional vigor, mildness of temperament, and large flow of milk they probably lead all other breeds.



KING SEGIS.

A Holstein sire having to his credit, at 5 years of age, daughters holding the world's record for junior two-year-olds, senior two-year-olds, senior three-year-olds, and twenty daughters with records of better than 20 lbs. of butter in seven days at two years of age.

Owned by H. A. Moyer, Syracuse, N.Y.

A thoroughbred animal invariably has four white feet and usually white legs, and the lower part of the tail is always white.

The ideal type of this breed is decidedly wedge-shaped as viewed from both the side and the front, with great length and breadth of rump, wide hips, loin slightly rounded, well-sprung ribs, deep and well-rounded body and large, capacious abdomen. The shoulders should be slightly lower than the hips and slightly rounded at the top. The neck should be long and slender and finely joined to a rather long head with wide muzzle. The forehead should be broad and slightly dished; large, clear, and prominent eyes and open nostril. The skin should be thin, soft, and pliable, the hair soft and silky, the legs strong and straight, the backbone high, sharp, and prominent, the ribs wide and well separated, the tail slender, and reaching to the hock joint or below.

The udder should be large, not pendent, but rather square, coming well out in front and well up behind, with teats of good size and well spaced. The veins should be large, tortuous, and extend well up toward the forelegs, dividing there into what is termed "extensions." The milk wells should be large, and the whole appearance of the animal should be that of ruggedness and power rather than of refinement and beauty.

The bull of this breed should have the general characteristics of the cows, except that he should be masculine in appearance, high-headed, straight, and handsome. His whole aspect should denote massiveness and power.

While the mature cow of this breed will show an average live weight of 1200 pounds, the bull will often weigh a

ton, and sometimes 2500 pounds. Breeders usually give preference to a bull having well-defined female rudimentaries, such as teats, milk veins, extensions, and milk holes.

THE CALVES

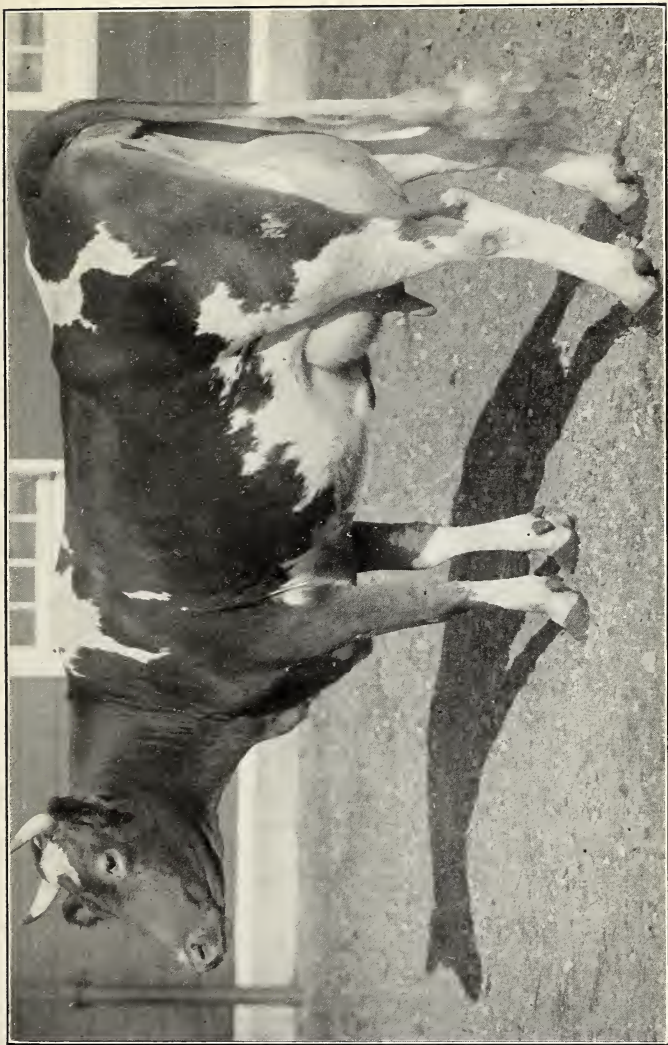
The calves of this breed are of unusual size at birth, frequently weighing from 100 to 110 pounds. They are strong and active and develop very early, the heifers frequently dropping their first calf before reaching two years of age. Some amazing butter records have been made with young heifers of the breed within recent years. Certain junior two-year-olds have made more than 20 pounds of butter in seven days, and at least one senior two-year-old has a record of 24 pounds made in seven days.

THE GUERNSEY CATTLE

Many dairymen and breeders believe that the cattle known as Guernseys are the most desirable of all breeds for dairy purposes, and certainly they possess many points that tend to justify the contention.

These animals are robust, gentle, and handsome, and have proven themselves possessed of wonderful capacity. The milk from this breed of cows is of excellent flavor, rich in butter fat and beautifully colored, while the quantity produced by them should satisfy any dairyman.

The mature Guernsey cow usually weighs about 1050 pounds, and should have a full, bright eye, with quiet and gentle expression, clean-cut head, long, slender neck, wide muzzle, open nostrils, backbone rising well between the shoulder blades, large and rather open spinal processes, pelvic arch wide, rump wide and strong, and carried



DOLLY DIMPLE.

Champion Guernsey cow.

By courtesy W. K. Hepburn, North Easton, Mass.

straight out to the tail-setting; tail long and slender, with full switch; thin, incurving thighs, ribs well sprung, wide of bone and spaced well apart; abdomen large and deep, skin loose, soft, and oily and always thin; milk veins long, crooked, prominent, and branching, with large milk wells. The udder should be full in front, full and well up behind, large but not meaty, with teats well apart, squarely placed, and of good size. The skin on the inside of the ear should have the yellow tinge that denotes the butter cow. The color should be a shade of fawn with white markings.

THE BULL

Generally speaking, the bull should show the same characteristics as the cow, except that he should be thoroughly masculine in appearance, with a well-crested neck, bold carriage, plenty of nervous energy, and at maturity should weigh 1200 pounds.

This breed of cattle was originally developed on the Isle of Guernsey, one of the British Channel Islands, and so carefully is the breed guarded that no live animal of any other breed has been permitted to land and live on the island for the past hundred years.

THE JERSEY CATTLE

In one respect at least, it is probable that no other breed of dairy cattle equal the Jersey, viz. in beauty. The rich, fawn color, beautifully shaded into black extremities; the graceful head, splendid eyes, bright and kindly expression of the face, at once stamp the Jersey as an animal that any one could love.

The ideal Jersey cow has a small, breedy head, with

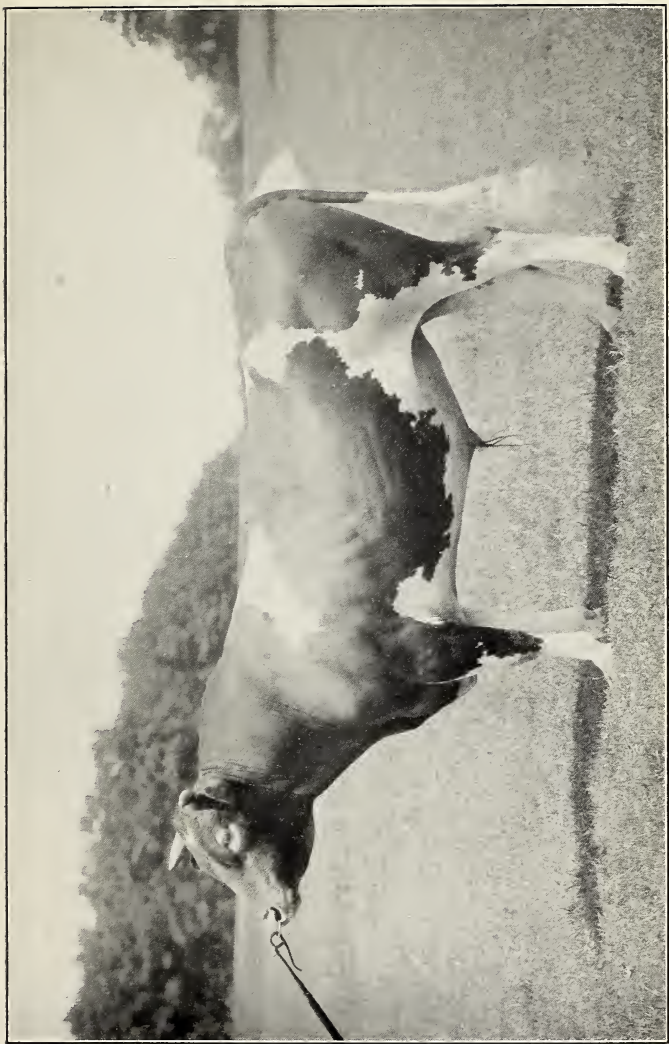
dished face; broad between the eyes, which are prominent, large, and bright. The horns are curved inward, are small, waxy, and usually tipped with black. The ears are small, very thin, and delicately shaded with yellow on the inside. The neck is long and delicate, legs short and fine of bone, body well rounded but deep, tail long and slender, ending in a fine brush. The skin is loose, mellow, and as yellow as butter. The hair is silky, fine, and short. The udder should be broad and nearly level, extending well up behind and well forward; it should be large but not pendent, and should not be cut up between the quarters. The teats should be of good size and placed well apart at an angle pointing away from, instead of toward, each other. The milk veins should be large, tortuous, and dividing into several extensions. The milk wells should be large, and placed well toward the front legs. The back should be straight from the shoulder to the tail-setting, and the head carried high. The whole appearance should be one of beauty and refinement, and the mature cow will usually weigh about 800 to 900 pounds.

THE BULL

The bull should be thoroughly masculine in character, long and straight of back, deep chested, high crested, and resolute. He should be the king of the herd and look every inch the part.

The milk of the Jersey cow, while less in volume than that produced by many other breeds, is very rich in butter fat, excellent in flavor, and splendidly colored, which render "Jersey milk" the most popular kind on the market.

While there is at present much controversy regarding



Imp. KING OF THE MAY.
A fine specimen of the Guernsey breed.
By courtesy of F. Lathrop Ames, North Easton, Mass.

the rightful place which the Jersey should occupy in the dairy, there is little question of the position she does occupy among consumers of milk.

While the Jersey may be, as her breeders claim, the ideal butter dairy cow, yet it is a question whether it is profitable to sell milk so rich in fat in competition with milk lower in fat, unless a considerably higher price is obtained. The cost of producing milk testing 6 per cent fat is nearly twice as much as for producing milk testing 3 per cent. It follows as a business proposition that the richer milk should bring twice as much per quart in the market. Ordinarily the cow giving a large flow of milk will show in her product, a lower percentage of fat than the cow giving a smaller quantity. In other words (other things being equal), the rule is, that as the volume increases, the percentage of fat decreases, and as the volume decreases, the percentage of fat increases.

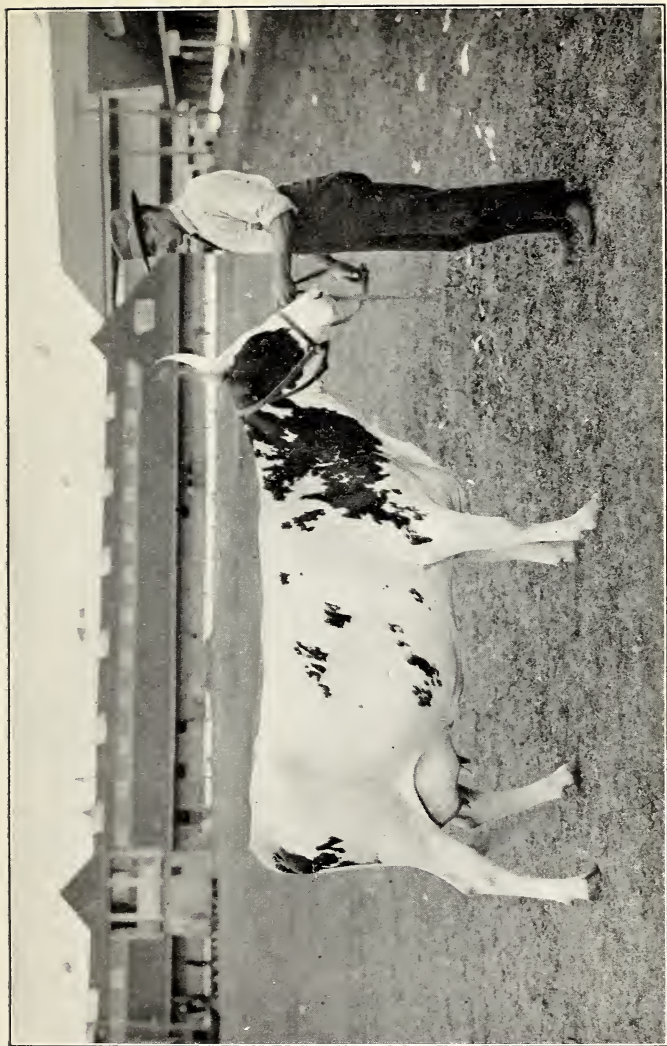
However, the production of butter fat is a complicated subject and one little understood, and under our present state of knowledge it is unwise to attempt to give advice regarding the most desirable breed of dairy cows to keep. The most that can be done is to state facts as far as known, and let each dairyman be governed in the selection of his breed by surrounding circumstances and conditions.

AYRSHIRE CATTLE

While the Ayrshire cattle are at the present time considered one of the principal dairy breeds, yet it is only recently that they have become prominent. Indeed, the history of the breed is short in comparison with some others, such as the Holstein and the Jersey.

The breed was developed in Ayrshire, Scotland, substantially within the last hundred years, and is probably the result of crossing the West Highland, or Kylo, cows with Alderney bulls. When we consider the hardships and privations which this breed of cattle has endured, it is surprising to note the development which has been attained by them as dairy animals. Food, always scanty at best, was obtainable in summer only by ranging the rugged mountain sides, while in winter the dairy ration was composed chiefly of bog hay, chaff, and roots. A grain ration was unknown, and springtime found the animals so poor and weak as scarcely to be able to stand. It was truly the survival of the fittest. From this unpromising beginning has sprung a race of cattle which, for hardihood and ability to withstand privation and still give milk, is unsurpassed by any other breed. Hardihood is interwoven with every fiber of the Ayrshires. They are preeminently "the poor man's cow"; they thrive on hill-sides and among rocks, inaccessible to other dairy breeds, and still respond well to liberal dairy treatment. They are not equal to the Holstein in volume of milk production; neither are they equal to the Jersey or the Guernsey in percentage of butter fat; but they will give milk under conditions where every other breed would fail, and they always appreciate good treatment.

A mature Ayrshire cow should weigh 1000 pounds, and the bull 1500 pounds. Their conformation is smooth, wedge-shape, straight of back and deep of body. The ribs are well sprung and well separated. The rump is broad and long, and is usually set higher than the shoulders. The horns are white, with black tips, and curve



Imp. CROFT JANE DINAH 19TH.
Grand Champion Ayrshire cow.
By courtesy of the Lotus Fields.

outward and upward, and grow longer than those of other dairy breeds. The udder is generally well developed, is large, well rounded and well set. The teats are usually well placed, but are frequently much too small and too short. In fact, one of the most serious criticisms of the breed is the lack of proper teat development. The color may be red, white or brown, or red with white patches, or nearly all white. The Ayrshire is mild and kind, but full of energy and reserve force and is always able to hustle for herself.

DUTCH BELTED CATTLE

The Dutch Belted cattle are a strictly dairy breed. Their native home is Holland, where they were originally developed and where the strange and beautiful color markings characteristic of the breed became a fixed and distinctive feature. It is not known by what method the Hollanders were able to produce such peculiar markings, but it is generally conceded that it required skill and knowledge of breeding of a very high order.

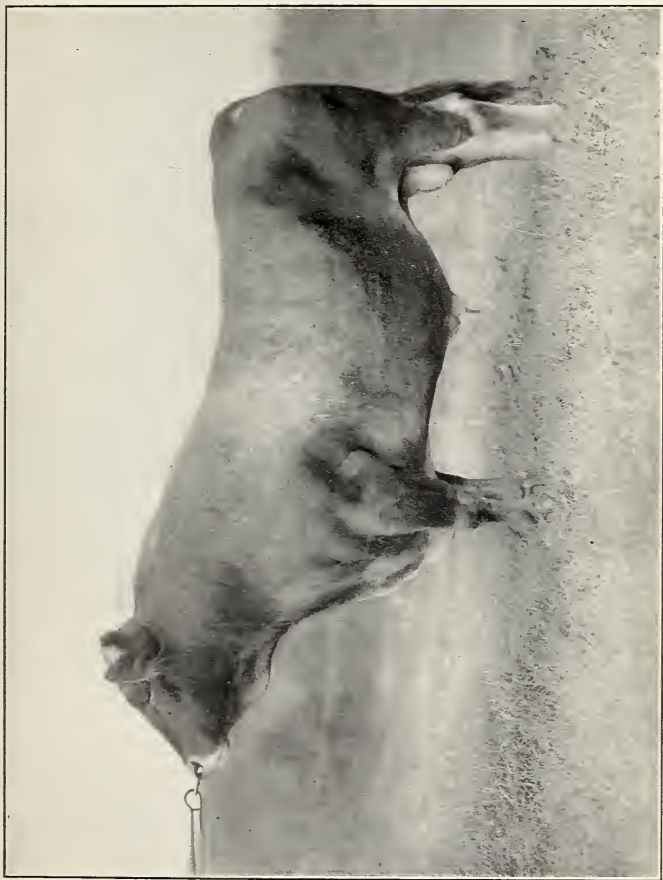
The distinctive characteristic of the breed is a wide belt of peculiar whiteness, extending entirely around the body between the shoulders and hips, the rest of the body being black. In size they compare favorably with other dairy breeds, being larger than the Jersey and smaller than the Holstein. They are quiet and gentle and highly developed as dairy animals. In conformation they are rather smooth, with straight back, small head, deep chest, hips and rump high and broad, good udders and milk veins well developed. The skin is mellow and the hair is soft, fine, and silky. They are persistent milkers, and produce fairly good results on very ordinary feed. They are not cattle

of the largest capacity either in the ability to eat or to give milk; still they make very satisfactory dairy cows, and are certainly picturesque and beautiful. They should not be confused with the Holsteins, as they are entirely distinct, forming a unique breed by themselves.

BROWN SWISS CATTLE

The American Brown Swiss cattle are generally known as dual-purpose animals, and, strictly speaking, should not be classed as a dairy breed. However, some individuals have made very satisfactory milk and butter records. These animals fatten very readily, are valuable as beef and probably produce better veal calves than any other breed. It is not uncommon to see a Brown Swiss veal calf weighing 250 pounds at six weeks old. The meat is white, is highly flavored and is considered the choicest upon the market.

The original home of this breed is in Switzerland, where they graze upon the mountain sides in summer and are fed upon hay alone during the winter. They are seldom fed grain, but respond readily to grain rations. They are a rugged, useful breed, kind, gentle and handsome. The mature cow should weigh 1200 pounds, and the bull 1800 pounds. The appearance and conformation of the Brown Swiss is quite the opposite of the Holstein, in that the former is symmetrical, lacking even a hint of angularity, and always having a sleek, fat appearance. The skin is soft, but very thick, which is quite the reverse of that found on every other breed of good dairy animals. The color is chestnut, shading from light to very dark. The peculiar markings are a light tuft of hair between the



UPLAND HOBBY.

A Brown Swiss specimen, of which the owner, Mr. F. R. Hazard of Syracuse, N. Y.,
may well be proud.

horns, on the inside of the ears, and a narrow line along the backbone. The nose, hoofs, tongue and switch are all black. The mouth is surrounded with a meal-colored band. A yellow strip commencing at the middle of the under lip extends across to the upper lip and up the sides of the nostril. The face is dishing, the eye full and clear, legs very short and straight. The teats are large and well placed, with a large and beautifully formed escutcheon. These cattle do well on rough feed, are gross feeders, take on fat quickly and for the double purpose of producing beef and milk are most valuable.

RED-POLLED CATTLE

The original home of the red-polled cattle was Suffolk, England, where they have existed from time immemorial. They are a dual-purpose animal, and as such are quite satisfactory for both beef and dairy purposes. The mature, finished cow weighs from 1300 to 1500 pounds, and the bull from 1800 to 2000 pounds.

In conformation they are low-set, with straight lines at both top and bottom. In color they may be any shade of red, with white switch and white udder, and the nose should be clear flesh color. The head, devoid of horns, should be of medium length, wide between the eyes, sloping gradually from the eyes to the poll. The poll is prominent, with a sharp dip behind the center. Ears of medium size, eyes prominent, face dished, muzzle wide, with large nostrils. The neck should be lean, but full from head to shoulders. Shoulders full and level with the line of the back. The chest should be deep and full, the back straight from shoulders to tail-setting and

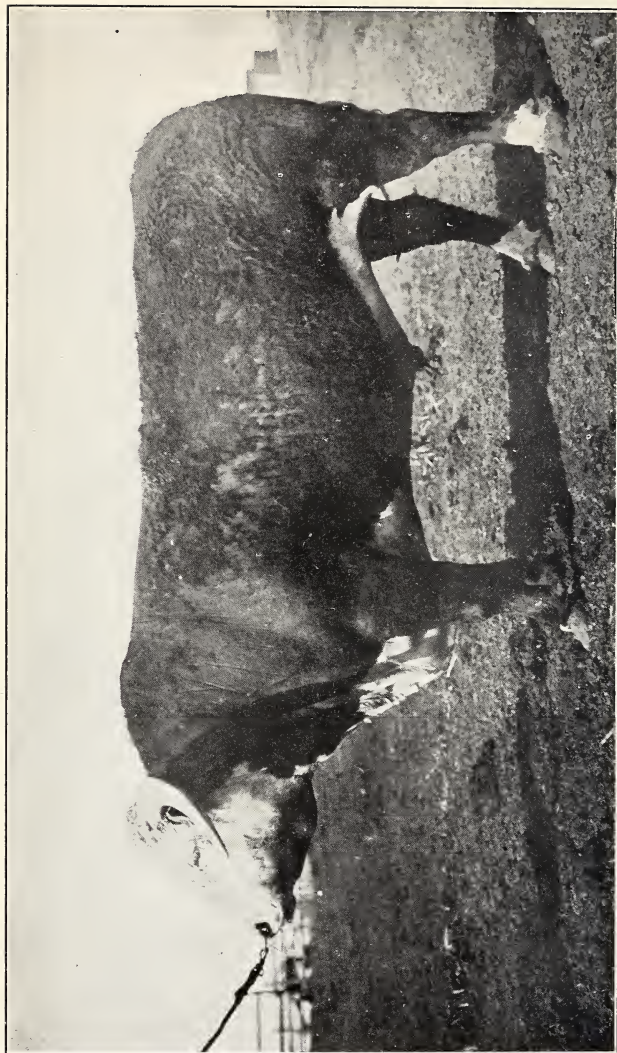
the ribs springing from the level of the back, giving a broad, rounded appearance. The quarters should be well rounded and full, legs short, strong and straight, and well placed under each corner. The skin should be loose, mellow and thick, covered with thick, soft hair. The red-polled, like the Brown Swiss, have their place of usefulness, and under certain conditions are most valuable; but it is doubtful if it would be wise for the dairyman to invest in such stock; while on the other hand the producer of beef can certainly find breeds of the purely beef type which will better serve his needs.

The dairyman must feed for milk production and not for beef, and the stock raiser desires to turn all of his feed into beef, and a large, or even a moderate, flow of milk is just the thing he does not want. However, there are conditions which render these animals desirable and perhaps necessary.

DEVON CATTLE

This is a dual-purpose breed, and because of the bright red color the animals are sometimes called "rubies." They are a hardy, active breed, and will thrive on short, hilly pasture and scanty rations, but respond readily to more liberal treatment.

The county of Devon, England, is the original home of these cattle. There the farmers have bred and prized them for nearly 300 years, where they were accustomed to obtain a living by roaming over the bleak moors and rugged hills of that region. As a matter of necessity they were compelled to "rustle" for a living, the effect of which was the development of a hardy, active and muscular breed of cattle.



HEREFORD BULL. SAILOR.
By courtesy of A. E. Cook, Odebolt, Iowa.

As oxen they have no equal, and the farmer who has a yoke of Devons is the envy of his neighbors. They are strong, active, fast walkers, easily trained and gentle. They are straight, handsome and useful in every way, but they are not quite good enough for dairy animals, and are rather too small for beef.

THE HEREFORD CATTLE

The Hereford cattle are primarily beef animals, and as such stand in the front rank. They excel especially in early maturity and are exceedingly valuable in the production of "baby beef." Their capacity as milk producers is very limited, which fact adds to, rather than detracts from, their value as range cattle.

Perhaps the most distinctive feature of the Hereford is the color marking. The head, jaws and throat, including the under part of the neck and breast, are white. Parts of the belly and of the legs are also white. The tail brush is white, as is the top of the neck. All the remainder of the body is some shade of red, varying in different individuals from a light or yellowish red to very dark red. Their color markings are very uniform and at once distinguish the thoroughbred Hereford.

The conformation of the body is long and box-shape, as seen from the side, but from behind it assumes the form of a barrel, being almost a perfect circle. The head is short and very broad between the eyes, eyes full, horns white, without black tips, and drooping forward. The legs are short, straight, and very strong, neck short and thick, hide heavy but loose, breast broad, back straight, and well carried out to the tail-setting; quarters so full

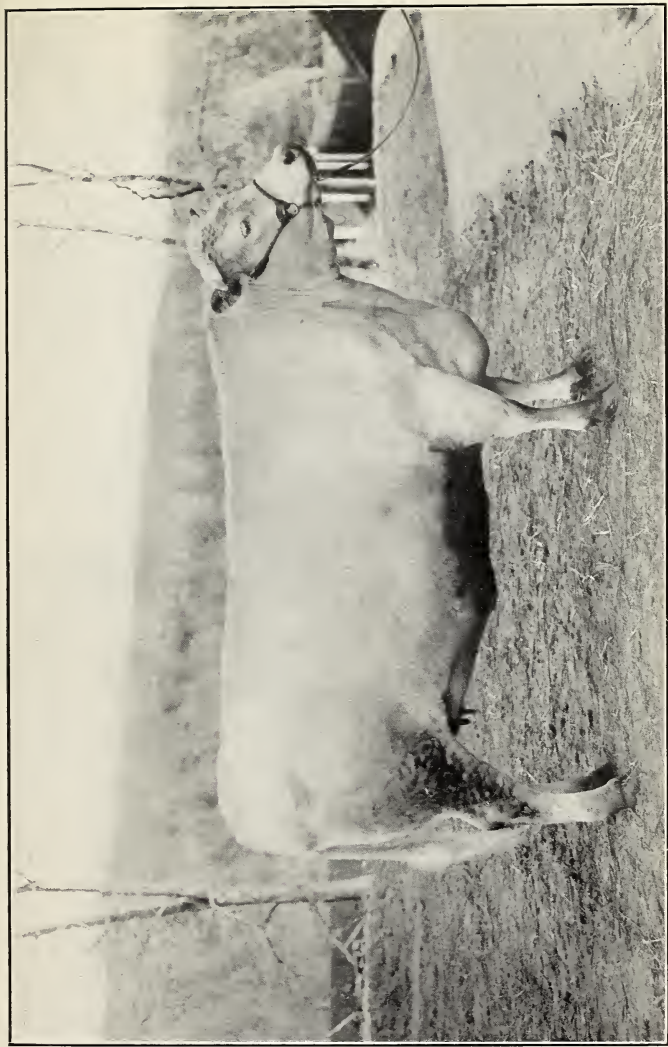
and heavy as to give the appearance of the end of a saw-log; and, finally, the flesh should so cover the body that all bones are buried.

Instead of a sharp, prominent vertebræ, as in the dairy type, the Hereford has a perfectly round back and, if very fat, frequently a line of depression where the backbone is situated. The hair is long, soft, and curly. As beef animals their great value lies in the fact that they can withstand the most rigorous climatic conditions, usually so trying to range cattle, their great capacity as feeders and rustlers, their tendency to store up large quantities of flesh at all ages, and their disposition to fatten while very young. A finished yearling will frequently weigh 1200 pounds. He can turn more grass into flesh than any other beef animal, and he can do the same thing with grain when turned into the feeding lots in the corn belt.

The Hereford cattle were bred and developed in the county of Hereford, England, commencing as early as 1600, and, like many other useful breeds, they reflect great credit upon the English breeders.

THE SHORTHORN CATTLE

Probably the most numerous registered cattle in the world belonging to any breed are comprised in the breed known as shorthorns. Breeders of these animals claim for them the distinction of being the best beef-producing cattle and also of high value in the dairy. While an inspection of these animals will easily convince any one regarding their beef-producing qualities, it is difficult to understand how they can excel as dairy cattle.



GOLDEN BUD.

A fine specimen of Short Horn.

By courtesy of W. H. Dunwoody, Long Lake, Minn.

In general conformation they represent the beef type in every essential. They are of great size, very deep and wide. The head is short and wide, the neck short and thick, the back straight, and deeply covered with flesh. The thighs are wide, deep, and long, the posterior lines of which should be almost straight from the tail downward, presenting the square appearance so desirable in the beef animal. The flanks are usually well let down, giving a nearly straight bottom line. The legs are medium length, straight, and strong. A fat animal of this breed has a tendency to lay on fat in bunches or rolls, about the tail and upon the sides, presenting an abnormal appearance. In color they are quite variable, there being no fixed type, as found in many other breeds. However, the nearest approach to a characteristic color is the roan; red and white are also common.

"Shorthorn" is simply a new name for an old breed of cattle, to wit, the Durham, with which many farmers were familiar in their boyhood days. They fattened easily, the steers brought good prices as beef, they made good ox teams, the cows gave a fair quantity of milk during the grass season, and all together they were very useful animals.

They have been very materially improved in recent years in many respects, so that to-day they occupy a very important place in the animal husbandry of this country. In common with most of the principal beef breeds, their original home was in England in the counties of Durham, Northumberland, Lincoln, and York, and they have been variously known as Durhams, Northumberlands, Lincolns, and Yorkshires, as well as Teeswaters, because of their

numbers on the Tees River. All of these names are now obsolete, and the term "shorthorn" comprises the whole.

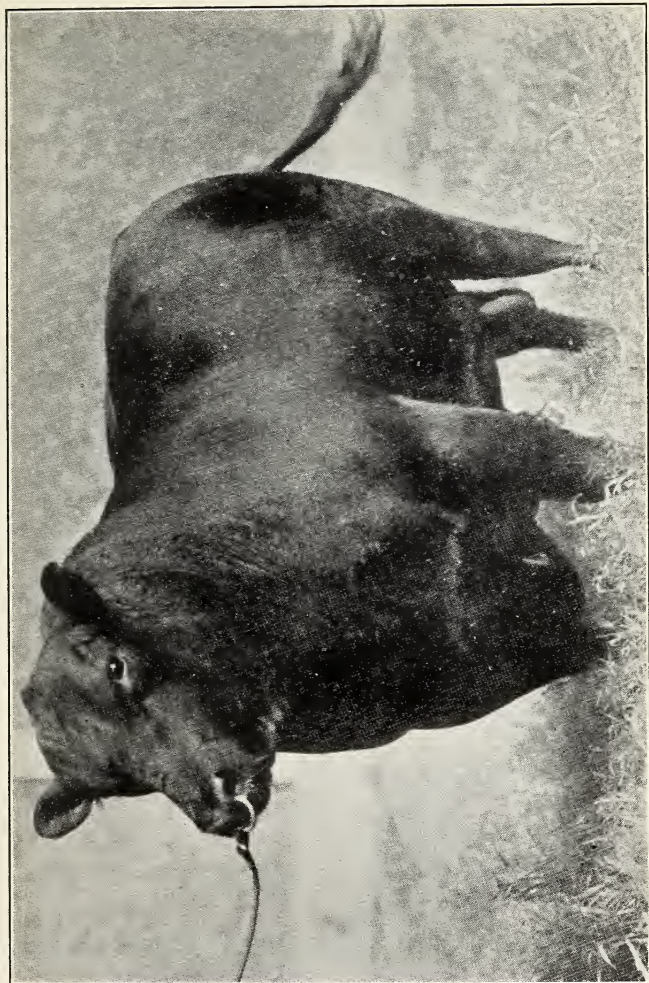
SUSSEX CATTLE

The county of Sussex, England, has the credit of developing a splendid breed of beef cattle known as the Sussex. In general conformation they resemble the Devons, but in size they rival the shorthorn, the cows weighing 1500 pounds and the bulls 2000 pounds, while the oxen of this breed frequently weigh as much as 2500 to 2800 pounds. While the number of these animals is smaller than those of many other breeds, still they occupy a prominent position in the production of beef and are in every way desirable.

THE GALLOWAY AND ABERDEEN-ANGUS CATTLE

The Scottish farmers must also be given credit for intelligent and patient work, in the production of the Galloway cattle along the southwestern coast of Scotland, and the Aberdeen-Angus cattle in and about Angusshire. All of these cattle are polled and are variously known as polled, humblies, muleys, and doddies. They are almost universally black in color, although formerly there was considerable variation in this respect, individuals presenting themselves in red, black and white, brindle, and sometimes with a dun-colored stripe down the back. It was in 1805 that Hugh Watson, of Kielor, announced his determination to have uniformity in color, and declared himself for the "doddie, black and a' black, and no surrender."

All of these animals are primarily of the beef type and make no claim to milk production.



GLENFOIL THICKSET.

Grand Champion Aberdeen-Angus Bull.

W. A. McHenry, owner, Denison, Iowa.

The Aberdeen-Angus are round, compact, and smooth, with short legs, deep, full hind quarters, and evenness of flesh. They take on flesh easily and make high-class beef. In one respect they excel almost all other beef cattle, to wit: in the marbling of the flesh, *i.e.* the blending of the lean and the fat in the carcass. While not so large as the Galloways, their splendid meat, compact form, and small bones secure for them a higher "dressing score" than is reached by most beef cattle. They are short-haired, sleek-coated, small-boned, and early maturing animals.

The Galloways are much larger cattle than the Aberdeen-Angus, with long, wavy, black hair, large bones, and are slower to mature.

There is no doubt that polled cattle (other things being equal) are more desirable than horned cattle. This fact is generally recognized throughout the country, both among dairymen and beef producers. Whole herds are being dehorned with the saw, and young calves are constantly being treated with caustic and hot irons to prevent the growth of horns. Beef animals take on flesh faster and dairy cows give more milk if there are no horns in the herd. The farmer can dehorn 90 per cent of his calves in nature's own way by simply securing a thoroughbred Aberdeen-Angus or Galloway bull for service among his grade cows.

OTHER CATTLE

There are, of course, many other interesting and valuable breeds of cattle which might be described, such as the Black Welsh cattle, the Brittany cattle, the Kerry cattle, the Holderness, the Normandy, the West Highland, and the Texas Longhorn, but the purpose in describing

the foregoing breeds has been to acquaint the dairyman and the stock raiser with the characteristics, desirable and undesirable qualities and most useful purposes of the several breeds with which he is most likely to come in contact. In other words, a careful reading of this portion of the work should enable the dairyman to determine which breed is best adapted to his needs and conditions, how to choose a good cow or bull, and to know the markings of a pure breed animal. On the other hand, the stockman and the beef producer should be able, by a little study, to select the breed best adapted to his needs and to choose the good individual and reject the bad — obviously of the utmost importance in selecting foundation stock and securing bulls for crossing purposes.

While this discussion of the subject may seem somewhat lengthy and possibly tiresome, it is given as a plain statement of facts, in plain words, for the benefit of practical farmers and stockmen.

CHAPTER XXVI

THE ORIGIN OF THE HORSE AND DEVELOPMENT OF VARIOUS BREEDS

THE *Equus* family is distinguished by a single hoof, a simple stomach, long, muscular legs, and a high order of intelligence, having a mane on the neck, and a tail covered with coarse hair, or terminating in a switch.

The earliest prehistoric horse existed in the lower Eocene period, ranging from Mexico northward and inhabited parts of Continental Europe and Great Britain. Fossil remains of the horse have been found in almost every country excepting Australia, and extinct species of the horse have been discovered in fossil remains in New Jersey, Nebraska, Colorado, South Dakota, and Wyoming.

The early horse was no larger than a small dog, was of dun color, had four toes on the front and three on the hind feet. The animal is known as "the dawn horse."

The next higher form was discovered in the fossil remains of the Big Horn Mountains of Wyoming, and had progressed to a height of 14 inches. In the Oligocene period the horse is found to be 18 inches high and having only three toes, the middle one being much enlarged and bearing most of the animal's weight.

Colorado furnishes the next step in the development of the prehistoric horse. This animal was 40 inches in

height, walked upon the middle toe, but had two lateral toes somewhat resembling the dewclaw of our modern cattle.

In the next stage all of the toes had disappeared except the middle one, which, being provided with a strong hoof, wholly supported the weight of the animal. The rudimentary toes of the ancient horse may still be seen in the form of splints on both the fore and hind legs, fitting closely to the bones at the side of the leg of the modern horse. The existing living forms which have not been modified or developed by man are small in size, wild, and very hardy. They include the zebras and the wild ass. Closely related to these is the extinct quaga.

All of these animals can be tamed and broken to harness and saddle. They will crossbreed one with the other, and likewise with our modern horses and asses, but the progeny is usually sterile.

The development of the mighty draft horse of the present day from such unpromising beginnings is a wonderful illustration of the power of selection in the breeding of domesticated animals.

CHAPTER XXVII

DIFFERENT BREEDS OF HORSES

THE ARAB HORSE

THE Arab horse is notable as a saddler, and for his power to impart vigor, quality, and intelligence in cross-breeding. His blood has been prominent in the development of the Percheron, Hackney, Thoroughbred, Russian Orloff, Triccaney, Hanoverian, and Coach horse. In fact, most of our present-day types are more or less directly traceable to the Arabian horse. The English Thoroughbred and the Hackney owe a very large part of their conformation, style, quality, and endurance to the influence of the Arabian; so, also, do the Thoroughbreds, Morgans, and trotting breeds in America.

DESCRIPTION

The pure Arabian is not a large horse, seldom reaching more than $14\frac{1}{2}$ hands in height; but, in the language of the stable, "he is a very big horse for a little one." He possesses high courage, vast endurance, great substance, and wonderful intelligence; is gentle, affectionate, and afraid of nothing. He carries his head high, and his tail as proudly as if it were the American flag. All together he has the elastic, graceful movement, the powerful and lofty carriage, which stamp him as the possessor of the bluest of all equine blood.

In color the Arabian is either white, black, gray, bay, brown, or chestnut. The piebald or spotted horse is never an Arabian. There are two features which cannot be mistaken in the pure Arabian, — the prominent forehead, giving a peculiar dish to the lower part of the face, and the proud and graceful carriage of his tail.

HISTORY

The history and antiquity of the Arabian horse antedate those of any other present-day breed by many centuries. Indeed, many hundreds of years before Mohammed, this splendid horse was widely bred and used by the roving tribes about Mesopotamia and Nejd. Early in the seventeenth century he was brought to England, and as early as 1838 to America.

UTILITY

Thousands of years of use under the saddle have necessarily developed in him high rank as a saddler, while the hard conditions under which he lived gave him such powers of endurance, ability to carry heavy loads and withstand the torture of heat and sun, lack of food and water, as would disable a horse of almost any other breed. At the same time he makes an attractive and gentle carriage horse.

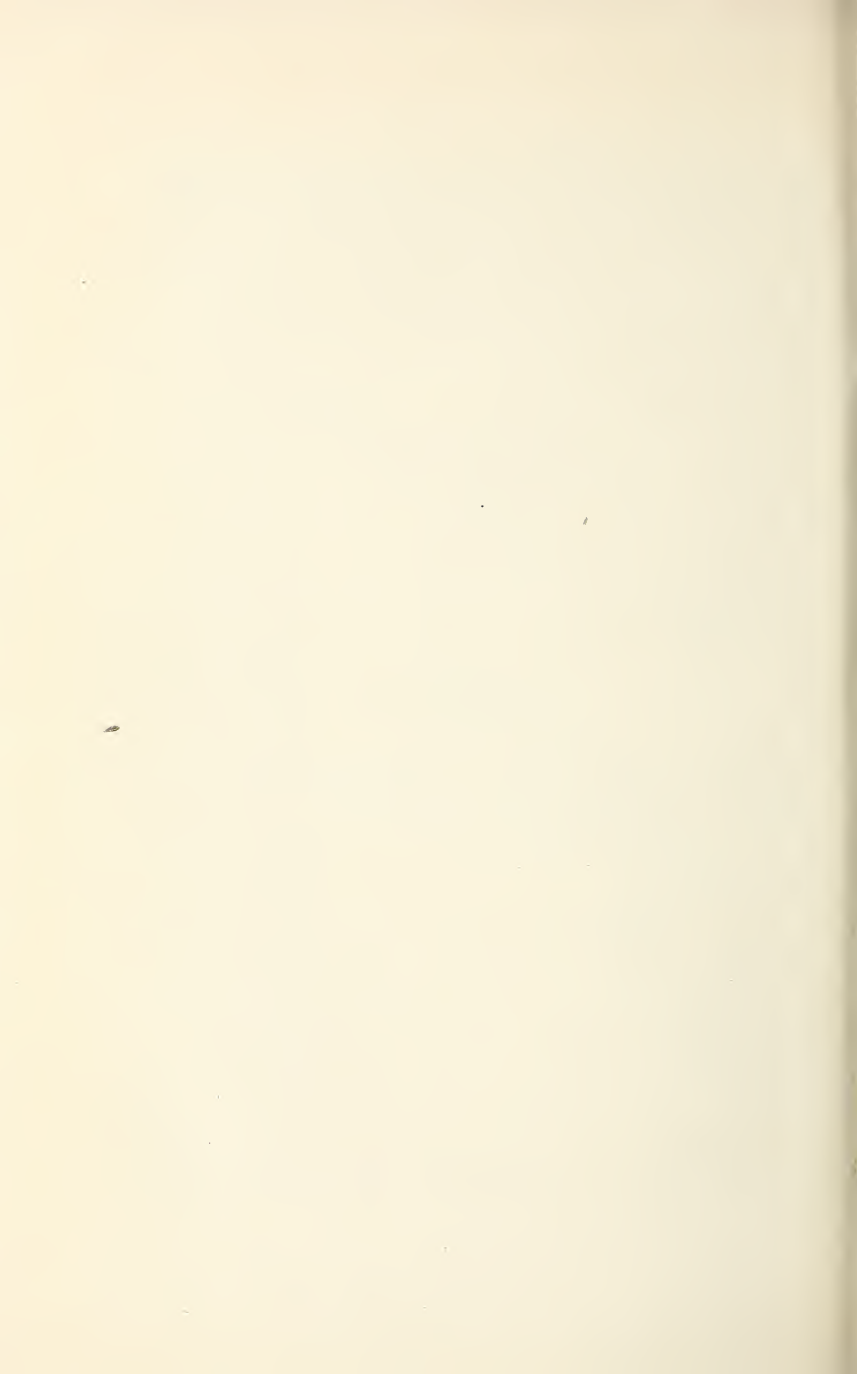
He requires only about one half as much food as other horses, needs regular and constant exercise, and is always ready. He is bred in purity in both England and America, and associations are being formed for the purpose of maintaining stud books and records of the breed.



MEANWOOD MAJESTY.

A perfect type of Hackney.

By courtesy of Papst Stock Farm, Oconomowoc, Wis.



THE BARB HORSE

Much resembling the Arabian in many respects, yet entirely distinct in breeding and history, is the Barb horse. He stands only 14 to 15 hands high, is short of body, rather long of limb in proportion to the body, broad, full forehead, large, clear, prominent, and flashing eyes, a trim muzzle, and thin, dilating nostril.

The head is carried high on a long, crested, arching neck, well cut out in the throttle, sloping shoulders, well-arched ribs, straight hind legs, long pasterns, deep, narrow feet of splendid texture, and tail set high and proudly carried.

He is a breedy-looking fellow, yet is gentle and kind. In color he may be dark bay, brown, chestnut, black, or gray. The darker-colored animals frequently have white markings, such as a star, a blaze, or white coronets.

HISTORY

The Barb is a product of the desert, — the horse of the Sahara, — and, like the Arabian, a thousand years of activity and usefulness, sharing the hardships or good fortune of his master, have produced in him a horse that is willing, powerful, and yet graceful and absolutely reliable.

USES

The Barb has been most potent in the improvement of many of our modern breeds of horses. For example, the crossing of the Darley Arabian, Byerly Turk, and Godolphin Barb with Barb mares produced the foundation of the present-day thoroughbred. The Percheron is the

result of an original cross between the native French mares and Barb stallions. The Hackney is the result of a union of the black Friesland trotter with a Barb stallion. The Cleveland bay is the result of breeding a Barb with the Yorkshire mares. It is also true that the German coach horse and the Russian Orloff trotter are the result of crosses of native mares with Barb stallions. The American trotter, excelling all horses of that breed in the world, traces his blood lines directly to the Oriental horse, either the Arabian, the Barb, or the Turk.

While the horse of the Orient was the potent factor in founding the present-day breeds of thoroughbreds, trotters, and pacers, yet the development of those breeds has advanced to such a degree of perfection as to far outstrip the honored progenitors of the breed. And to-day the breeder of trotters or pacers would not think of breeding to any of the pure-bred Oriental horses to improve the breed of his racing stock. Neither would the breeder of Hackneys breed to such animals to improve the action or style of his stock.

While the Oriental horse lacks the extreme speed powers of the modern race horse and the exaggerated style of the Hackney, yet his graceful movements, symmetry, finish, and fine disposition largely offset his lack of those qualities, and give him an important place in supplying the market demand for animals of that character.

THE THOROUGHBRED HORSE

The "thoroughbred" is a term used to describe the running-race horse. By many he is believed to be the only present-day horse of absolutely pure blood. It is true



PETER THE GREAT. (2:07 $\frac{1}{4}$.)

Probably the most successful living sire of early and extreme speed. Owned by Patehen Wilkes Stock Farm, Lexington, Kentucky.

By courtesy of W. E. D. Stokes, New York City.

that for three centuries the English running horse has been bred, developed, and raced in various parts of Great Britain, and more recently in America and other countries, with the sole object of producing the utmost possible speed at the running gait. As might have been expected under such conditions, the thoroughbred has developed speed powers quite unknown in any other breed of horse, ancient or modern. His entire conformation indicates fleetness; his smooth, fine hair, thin, soft skin showing well-marked blood vessels, and the flashing, large, prominent eye stamp him at once as the "blue blood" of the equine race. He is a gentleman not born for honest labor, but for sport; hence, it is only natural that he should assume to claim the only really pure blood in the horse world. A moment's reflection, however, along the lines of his breeding will indicate the fact that if the English thoroughbred is of pure blood because his pedigree extends into the past for 300 years, how infinitely more pure should be considered the blood of the Barb and Arabian from which he sprang, whose breeding is traceable for more than a thousand years. And still the Barb and the Arabian are not even classed as thoroughbreds. But, then, they are not sportsmen, and, in fact, perform useful, honest toil.

THE TROTTING AND PACING HORSE

The American-bred trotter is a striking illustration of what may be accomplished in a very few years by intelligent breeding with a single purpose in view and an ideal to be attained. The trotter is a purely artificial product in breeding, and the trotting gait at speed is wholly an acquired mode of travel. Still, so strong is the power of

inheritance, so controlling the prepotency of well-developed parentage, and so certain the transmission of desirable results under intelligent breeding, that the American trotter belongs in a class by himself. The artificial and acquired gait has become his natural gait, as perfectly inherited and firmly fixed as the running gait of the thoroughbred, so that in recent years it is not uncommon to see an American-bred trotter or pacer going at full speed around a race course, guideless and riderless, for the pure love of the sport.

It is true that there is an absence of fixed type in the trotter such as is found in the various other breeds, and hence it is quite impossible to describe him. He seems to come in all sizes, colors, and shapes, rarely laying claim to much beauty of conformation, but always ready to try conclusions in tests of speed.

THE PACER

The pacer differs very little from the trotter, except that he is lateral gaited rather than cross gaited. In other words, he moves forward the front and hind feet of one side at one stride, and the front and hind feet of the opposite side at the next stride. The trotter, on the other hand, moves forward the front foot of one side and at the same time the hind foot at the opposite side. The pacing gait gives an appearance of ease and smoothness, and faster miles have been made at that gait than at the trot. It should be remarked that both pacer and trotter are from the same original Barb and Arabian stock. The pure-bred trotters are often inclined to pace, and horses bred by pacers frequently trot; finally, by proper treatment,



WINCHESTER.

Three-year-old pure-bred Kentucky saddle stallion, owned and ridden by the author's wife.

many race horses have been converted from one gait to another.

Unlike the thoroughbred, the trotter serves many useful purposes besides that of a race horse, and most of them sooner or later reach the plane of the common work horse.

THE SADDLE HORSE

The distinguishing characteristics of the saddle horse should be beauty and ease of motion, and to these should be added courage, docility, and finish. He should have a good head, small, pointed ears, large, prominent eyes, long, well-crested neck, sloping shoulders, short back, deep chest, good lung and heart capacity, well-sprung ribs, strong across the kidneys, with long and well-muscled quarters. The tail should be set high and carried in a high, flowing arch. The legs should be strong, fairly straight and flat, with sloping pasterns, feet strong, and heels well spread. He should be $15\frac{1}{2}$ hands high and weigh 1000 pounds.

HISTORY

The American saddle horse is an outgrowth of early American necessity. In the days before railroads the saddle horse was the principal mode of conveyance from one part of the country to another, and the horse capable of carrying the traveler the greatest distance with the largest degree of comfort was the most valuable for such a purpose. With the object of producing such animals the breeding of the saddle horse began.

While the thoroughbred enters largely into the development of the saddle horse, it is a curious fact that the first horses successfully used to cross with the thoroughbreds

to supply the saddle gait were Canadian stallions. The Canadian had developed a certain breed of horses having a gait called the "amble."

They were rather small in size and not very attractive in conformation, but they were strong and hardy, and the cross with the New England thoroughbred resulted in a very superior saddle horse. Unlike many other breeds of horses, the American saddle animals are practically all descendants of the one great saddle-horse sire, Gain's Denmark, and the prepotency of this horse was such that, although he has been dead many years, few breeders would engage in the business without first securing animals tracing directly to that great horse. A really first-class saddle horse brings a very large price in the market, and is always difficult to obtain, while a combination saddler and driver in all respects desirable is a treasure which few can possess.

THE COACH HORSE

There are several more or less distinct types of coach horses, each possessing special merit in differing respects, and open to fair criticism in others.

In general conformation, however, the Coachers, whether French, German, or English, are governed by the same general description. They stand from 16 to 16½ hands high, weigh from 1250 to 1450 pounds, are generally upstanding, carry both heads and tails high, and have bold, high knee action and regular, uplifting hock action. They usually have long, graceful necks, fine and intelligent heads, round, snugly ribbed bodies, muscular quarters, with usually good feet and legs. When in action, they present a picture of airiness and gracefulness not found



GERMAN COACH STALLION.

Imported and owned by J. Crouch and Son, La Fayette, Ind.

in any other large breed of horses. They are capable of drawing loads of considerable weight at fair speed, and always present the showy, grand appearance which most people admire.

In color they may be bay, brown, black, or chestnut, and occasionally gray, but the latter is looked upon with disfavor.

The Coacher of the present day is distinctively the rich man's horse. He is too long of leg to meet the requirements of a draft horse, too high in action to endure long and hard road work, and his gait is not suitable for saddle purposes. At the same time there is always a good demand for well-mated coach teams, which bring the highest market price.

THE MORGAN HORSE

This family of horses takes its name from Justin Morgan, sired by True Briton, and he by Imported Traveller, and he in turn by Morton's Traveller, following in direct lines back to that famous horse, Godolphin Arabian. Justin Morgan was a small horse, only about 14 hands high and weighing but 950 pounds.

Dark bay in color, with black points, very stylish, of indomitable courage but easily controlled.

He was the sire of three sons, each of which achieved considerable renown as prolific sources of trotters, viz. Sherman, Woodbury, and Bulrush, and from these has descended a long list of horses which, in the early days, occupied a rather prominent place in the trotting world.

It is not for extreme speed, however, that this family is best and most favorably known, but chiefly because of the wonderful endurance, the great beauty, the free and

easy style and action of its members. The Morgan is justly renowned for his bold, open, tireless gait and fine disposition.

He can cover more miles in a day or a week than most horses, and do it in good style, always a willing and snappy work horse, frequently a good saddler, and he gives the best there is in him all the time.

Perhaps he comes nearer being an all-round general-purpose horse than any other, and best of all he is "American bred."

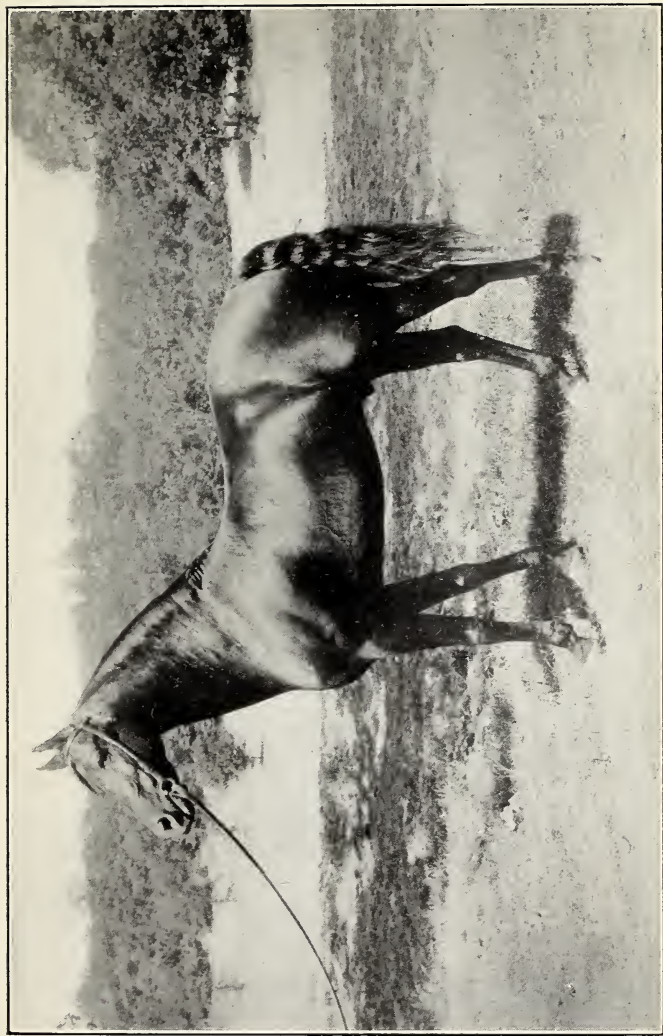
It is to be regretted that a family of horses brought to such a degree of excellence and possessing so many splendid traits should be allowed to retrograde by careless and ignorant cross breeding and out breeding, so that to-day it is almost impossible to secure a pure-bred Morgan.

His great merit was well known, his distinctive qualities were well established, and if his breeding had been maintained in its purity and carried forward with persistency and intelligence, the Morgan horse would have made New England famous.

To most of us he is to-day only a memory, but he has demonstrated the fact beyond question that the best possible horses can be bred and developed upon the American farm.

Recognizing the above facts, the federal government has established a breeding station in Vermont in co-operation with the Vermont Agricultural Experiment Station, with the object of "saving the Morgan."

The stud is headed by General Gates by Denning Allen (sire of Lord Clinton, 2 : 08 $\frac{3}{4}$), and out of a thor-



GENERAL GATES.

At the head of the United States Morgan Horse Farm, Middlebury, Vt.

oughbred mare. It is hoped that satisfactory results will be realized from this laudable undertaking.

HEAVY DRAFT HORSES

THE BELGIAN DRAFT HORSE

The heaviest breed of horses found in America is the Belgian Draft Horse. He possesses a maximum of weight in the most compact form. The body is short and set on very short legs, with short, thick, well-crested neck, deep, upright shoulders, broad and deep chest, ribs well sprung and set closely up to the hip. His back is short, very broad, and inclined to sag; loins wide and thick, flank low and full, quarters wide, short, and muscular. His legs are sometimes criticised as being too meaty and the tendons not clearly defined, giving the leg a rounded instead of a flat appearance. The feet, also, are criticised as being too small and the heels too high. Complaint is also made because the horse is sluggish in temperament; but it should be remembered that the Belgian is the heaviest of all our horses, and as "large bodies move slowly," this splendid horse is no exception to that rule.

Besides being most useful in drawing very heavy loads in our large cities, the stallions of this breed are very successfully used in crossing upon grade mares. Such crossing produces weight and substance as well as depth of body, short legs, good feet, and general massiveness not easily secured by the use of any other breed of draft stallions. In color the roan and chestnut are most frequently met with, but brown and bay are common, and gray is sometimes seen. The weight of the Belgian draft

horse at maturity may range from 1800 to 2200 pounds, and stallions sometimes reach the enormous weight of 2500 pounds.

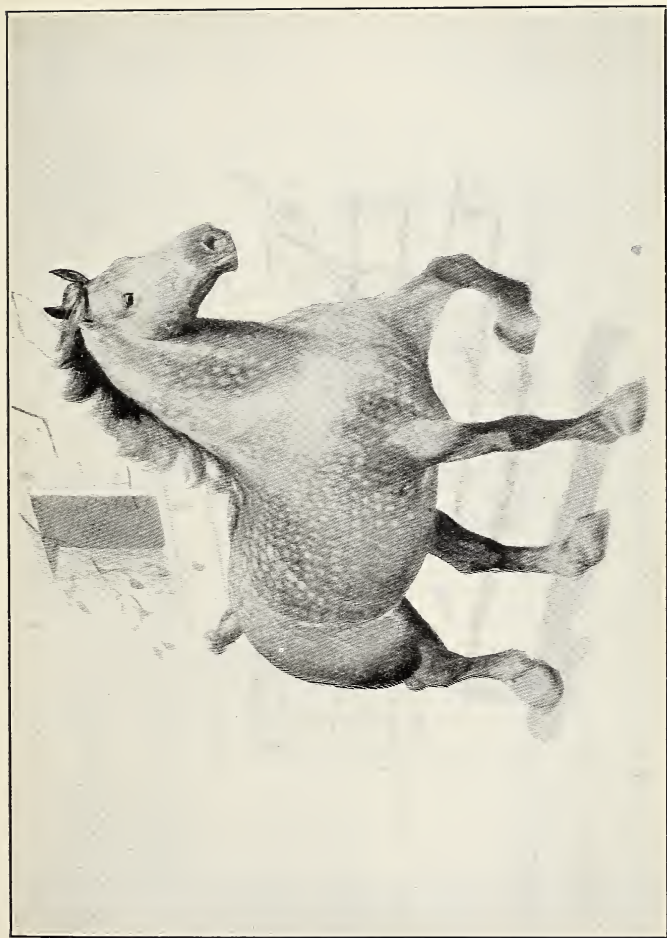
THE PERCHERON HORSE

The most noted of the several breeds of draft horses produced and developed in France is the Percheron, a native of the province of La Perche, a small territory only about 100 miles square; but from this limited region has been imported to America and other countries more draft horses than from any other country. Indeed, not alone in numbers, but in popularity, the Percheron easily leads among the various breeds of draft horses in the United States.

Strange as it may seem, the mighty Percheron of to-day was originally the result of an early cross of the Arabian stallions with native French mares. In 732 the French defeated the Saracens and captured their horses, and for a thousand years the Arabian stallion has infused his blood with that of the French mares. Later, the heavier types became in great demand, which led to the use of the heavy Flemish stallions, and from this combination the modern Percheron is descended.

DESCRIPTION

Present-day Percherons are endowed with what may be termed active temperament, great intelligence, open, quick action, splendid style, endurance, and activity. The body is deep, breast and shoulders wide, short of back, ribs well sprung and placed close to the hip, wide, muscular quarters, flat, clean-cut legs, and round, large feet. He is almost always kind and gentle, but full of



SAPINETTE.

A beautiful Percheron mare, imported by Oaklawn Stud, Wayne, Ill.

spirit, and is ready to work almost as soon as the harness is put on. In short, he requires but little breaking, and a "balky" Percheron is almost unknown.

HOW THE BREED WAS DEVELOPED

While it is undoubtedly true that the climate, soil, topography of the country, temperament of the farmers, the grass and bountiful crops within the little province of La Perche have had much to do with the development of this splendid horse, still, one of the important, if not the controlling, factor is the system of governmental control and breeding regulations which have been in force in that country for more than a century. Under the law governing the service of stallions, every stallion is required not only to be registered, but he must be subjected to a rigid examination as to soundness, proper conformation, etc. If he passes this examination, he is branded under the mane with a five-point star. This entitles him to stand for public service for one year; but at the end of that time he must be again examined, and if diseases have developed, he is branded over the star with the letter "R," which means "refused," and his service is at an end.

In addition to this governmental control the French Percheron Society subjects every animal, male and female, offered for registry to a most rigid examination by competent veterinarians, and all such horses are divided into three classes. Those in the first class are known as "subsidized," or "approved," and to this class a bonus is paid for the purpose of keeping them in France and to continue to breed and improve this wonderful stock. The other two classes are known as "authorized" and "certified," which

gives them the right to breed and to some extent indicates the stamp of authority, but does not entitle them to any subsidy.

Many of the diseases, ailments, and conditions of unsoundness so common in our American breeds are almost unknown to the French breeder. Breeding for a hundred years or more toward an ideal type has resulted in fixing that type so that every individual is a true representative of the breed, with the result that millions of dollars are exchanged every year with the farmers of that little province for the Percheron horses which they have learned how to raise.

COLOR

In color the Percheron is usually gray or black, but bay or chestnut is sometimes seen.

USES

The Percheron is essentially a draft horse, in which respect he has no superior and few equals. As a sire of draft horses from grade mares he has demonstrated his usefulness to a degree unequaled by any other breed. Almost all of our draft teams have more or less Percheron blood.

INCREASE IN WEIGHT

Within the last half century the breeders of the Percheron horse have materially increased his size and weight, so that to-day the "ton horse" is a very common expression among buyers and breeders alike.

THE CLYDESDALE HORSE

Scotland comes to the front again as the home of the great Clydesdale draft horse, which is known as the oldest breed of the British draft animal.

In disposition they are quiet, of good courage and true. Their weight is from 1700 to 2000 pounds for stallions, and 1500 to 1800 for mares, and the average height is from 16 to 16½ hands. In color the breed is not so uniform as in most of the other draft breeds, and may be brown, black, or chestnut, with white face and white legs below the knees and hocks; but in conformation the best specimens show a striking similarity. They generally have good, intelligent heads, good shoulders, high withers, good muscles, clean, flat legs, and always an abundance of feather. This feather, which is long, fine, silky hair, should spring from the back tendon of the leg, and is considered a mark of considerable merit by breeders of this animal. It is contended that the fineness of the feather indicates the fineness of the bone, tissues, and skin, whereas a coarse, wiry feather indicates a coarse leg predisposed to grease and scratches.

These horses have no equal in respect to the set of the hind legs and clean, powerful hocks, while their forward action is true, open, and snappy.

The criticism usually made regarding the Clydesdale has reference to the short, straight-set pastern, the undesirable length of the body, and the lack of depth in the shorter ribs. Many of these defects have been overcome in recent years, and without doubt most of the criticism will soon disappear; but it is true that the American

breeder considers the hairy leg of the Clydesdale very unsightly and the feather quite useless. However, the Scotch breeder will never consent to abandon his beloved "feather" because of the whims of the rest of the world. Neither will he change the white legs, which it has taken hundreds of years to fix as breed markings, simply because the trade in recent years does not like white patches.

DISTRIBUTION

Probably no other breed of draft horse has enjoyed a wider distribution throughout the world than the Clydesdale. He is found in every English-speaking country, including vast numbers in Canada, the United States, New Zealand, and Australia. Many of the best Clydesdales have found their way into the Argentine Republic, to Germany, Sweden, and Russia, while South Africa is rapidly adopting the Clydesdale as the national draft breed; all of which goes to prove the adaptability of these splendid horses.

The remarkable fact regarding this breed of horses is that the Scotch farmer, unaided by government, without organization, with only tenacity of purpose and adherence to his ideals, should be able to develop such an animal and thus make his country famous.

THE SHIRE HORSE

It is remarkable that horses of entirely different breeds, developed in different countries under unlike conditions and by very different people, should still possess so many characteristics in common as to sometimes make it difficult to decide to which breed they belong.

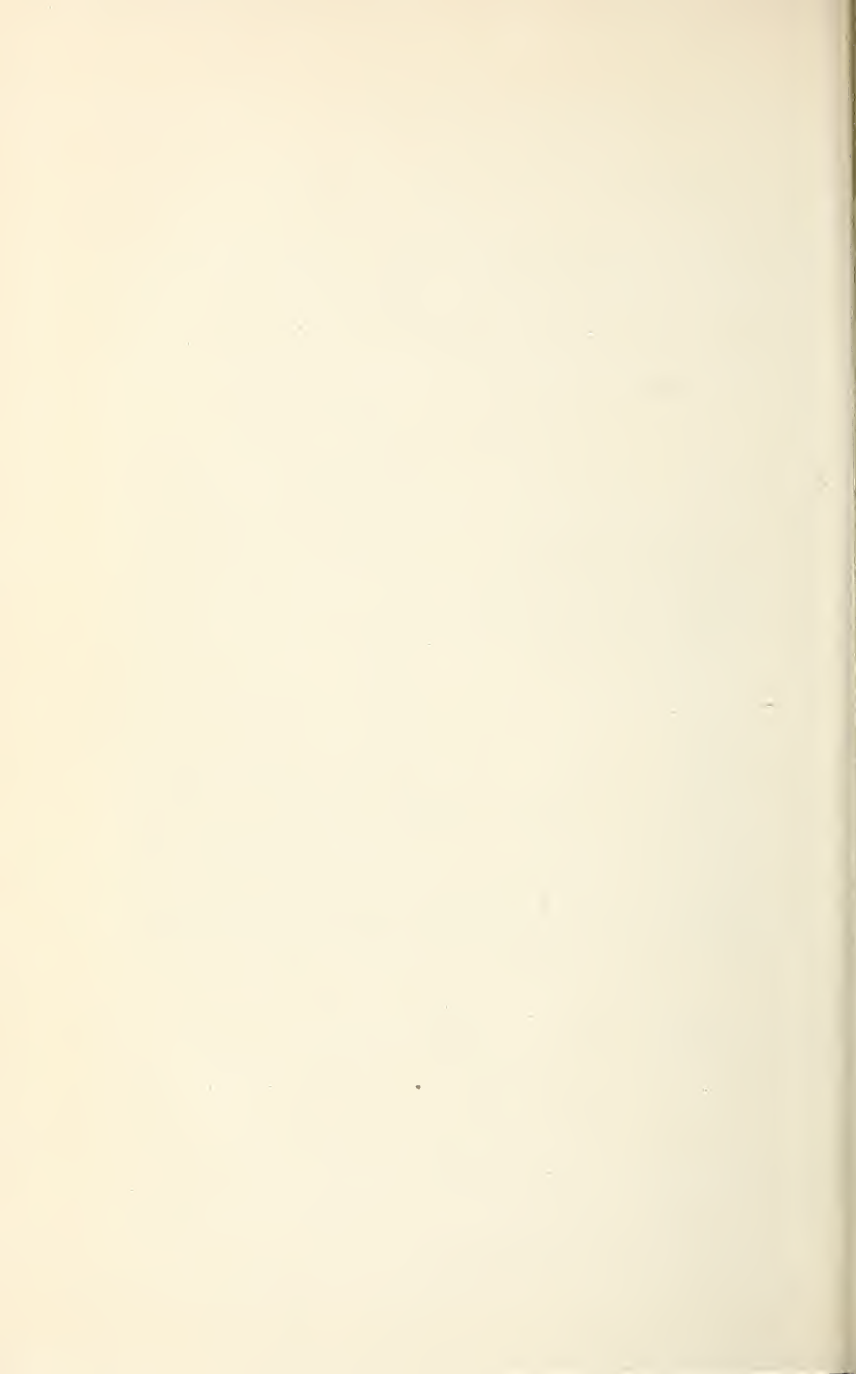
Such is the similarity existing between the Shire and the



TOM DARNLEY.

A good specimen of Clydesdale.

By courtesy of Dr. A. M. Seaman, Hornell, N.Y.



Clydesdale horses; and really good judges are often at a loss just where to place them, especially if the individual is a grade animal. The Shire and the Clydesdale correspond very closely in weight, color, and size. Both have the white face or strip, and white legs or feet. The "feather" is also present in both, while the general aspect of each is very largely the same.

There are, however, many differences between the two breeds, which may be readily observed by the breeder or buyer. The Shire is generally a little larger and heavier than his cousin, the Clydesdale, is slower, less active, of larger girth, better coupled up, and shorter in the legs. He is inclined to be sluggish in temperament, but is absolutely reliable, and performs in the most satisfactory manner the work for which he is designed — the hauling of very heavy loads at a slow pace through crowded city streets.

HISTORY

The Shire has been developed in the lowlands of England, principally in Lincolnshire and Cambridgeshire, and, in common with most draft breeds, the foundation seems to have been secured by crossing native mares with stallions brought from Flanders sometime during the eleventh century. These black Flemish horses were possessed of great weight, were sluggish, slow, and showed but little finish, but they have been able, when crossed with native mares of other countries, to produce breeds capable of splendid development in very many respects. In fact, every one of the draft breeds has, at one time or another, been favored with crosses with the black Flemish horse, from which it is believed the kindly disposition, the size, weight, and draft qualities were originally secured.

CHAPTER XXVIII

GENERAL DISCUSSION OF THE HORSE

IN the preceding chapter each of the more common breeds of horses has been described separately and somewhat in detail, because only in that way could the reader be made familiar with the characteristics, adaptability, and special uses of the various breeds.

The writer is intensely interested in the subject of improving the character of the horses bred and used in this country, believing that we should be able to produce horses a little better than the best. It is not pleasant, however, to be compelled to state that there are no distinctive breeds of American horses, with the possible exception of the trotter. While the farmers of this country have given much time, study, and labor to breeding and developing dairy cows, beef cattle, sheep, swine, poultry, and almost every domestic animal, and in nearly every case have outstripped the breeders of other countries along the lines best suited to their requirements, still in the breeding of horses very little advance has been made, and foreign breeders decline to import our horses because they are inferior to those of almost every European country.

POOR BREEDING

Among the farmers of this country it has been a general practice to work the young, vigorous, sound mare, and breed the old, useless cripple. Even a pure-bred sire was

not sought for; but any alleged trotter, pacer, or mongrel stallion standing at the country crossroads, charging a nominal fee, was considered good enough to breed from. The result of this practice was, perhaps, a little worse than might have been expected; but if a direct attempt had been made to breed cripples and ill-formed animals, it could not have succeeded better. The whole country abounds in undersized, evil-looking animals, worthless to keep and difficult to sell at a remunerative price.

GOOD BREEDING

Many millions of American dollars are exchanged every year for the *good* horses of Europe, while with all of our money we are seldom able to secure the very best. We have many advantages of climate, soil, abundance of feed of all kinds, cheap pastures, and a never failing home market, and we should be producing the best horses in the world, not only for our home market, but for the foreign buyers as well.

If the farmers of this country would patronize only stallions of size, good conformation, absolute soundness, and, as far as possible, only registered, standard-bred horses, and use for breeding none but their largest, soundest, most vigorous, and most valuable mares, the horse interests of this country would be revolutionized in six years.

From such intelligent breeding would soon be developed the American draft, coach, or hackney, winners in every class, as the American trotters and pacers are at the present time. A careful study of the various breeds described in the preceding chapter should aid any farmer in

determining the one best suited to his needs, market, and circumstances.

SOME FACTS ABOUT BREEDING

It is a fact which may as well be cheerfully admitted that the farmers of several foreign countries are much farther advanced in the science of breeding than are those of the United States. Our well-bred animals are, almost without exception, derived from imported stock, and, strictly speaking, there are no distinctive breeds of domestic animals which can be truly classed as American-bred.

While many breeds of domestic animals have undoubtedly been improved by our breeding, still, almost without exception, the leading characteristics of the breed are such as were established by the foreign breeder. The beautiful English thoroughbred, the splendid Percheron, or the magnificent Belgian horse could be established as a distinct breed only by patient, intelligent farmers who understood the rules of breeding and the laws which control the reproduction of domestic animals. It is certainly quite possible for the American farmer to establish distinctive breeds of domestic animals superior to those produced in any other country, if some of the simple rules of breeding are put in practice with intelligence for a series of years.

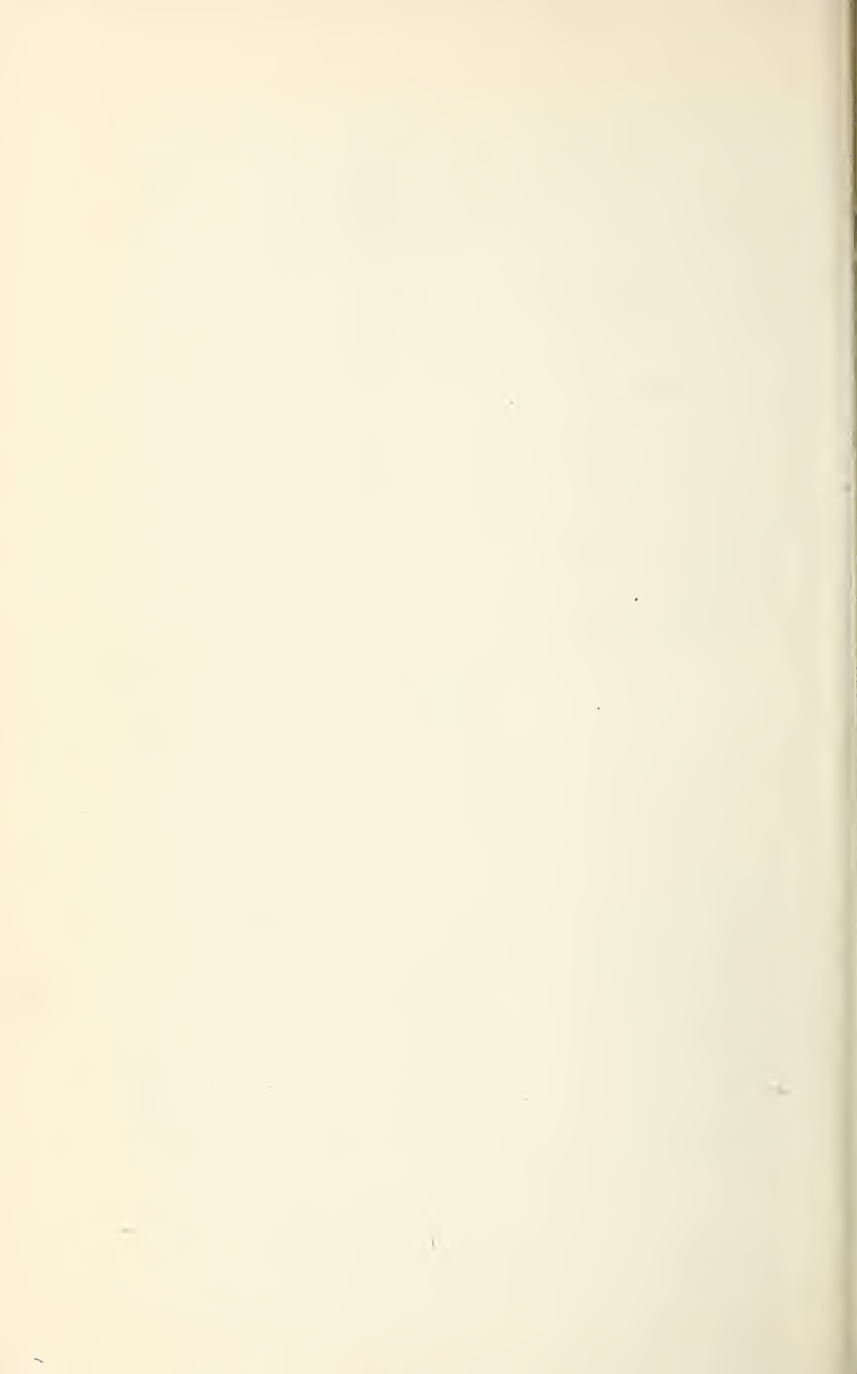
Some of the Rules. — Never crossbreed. In other words, do not cross one well-established breed upon another well-established breed, as, for example, a pure-bred Holstein bull and a pure-bred or high-grade Jersey cow; or a pure-bred Percheron stallion with a pure-bred or high-grade Clydesdale mare. The result of such a course, so far as breeding is concerned, is always a step backward and not forward; it is breeding away from type and not



PERCHERON STALLION.

A valuable asset in any farming community.

By courtesy La Fayette Stock Farm, La Fayette, Ind.



up to type, and instead of producing progeny with superior characteristics, it will in all probability be inferior to either parent. In short, the crossing of two distinct breeds always tends to revert back to the foundation stock.

A familiar illustration will serve to demonstrate this point: suppose the breedy-looking greyhound is bred to a thoroughbred collie; the result will be a litter of wire-haired, mongrel pups that no good farmer would allow to live on his place, inferior to either parent and resembling as nearly as possible the wild coyote, from which all dogs are popularly supposed to have originated.

Another illustration of the result of cross breeding which may be noted, in the case of pigeons. If the breedy-looking homer is crossed with the proudly strutting fantail, the result will be a blue, striped-wing, rock pigeon, the foundation bird from which all pigeons sprang. Stated, then, in its simplest form, the rule is this: Cross breeding tends to destroy all distinctive qualities which years of patient, careful breeding have secured; while careful selection of animals of the same breeding, or even careful line breeding, will tend to improve every desirable quality found in any particular breed. The farmer who has secured a herd of grade Holsteins should continue to use only a pure-bred Holstein bull, and never on any account change to a Jersey, Guernsey, or Ayrshire bull. If the blood of the Percheron predominates in his brood mare, he should secure the services of a thoroughbred Percheron stallion, and on no account use a Clydesdale, Shire, or Belgian stallion simply because there happens to be such a horse in the neighborhood.

There is one possible exception where it is permissible

to violate this rule: it frequently happens that cross breeding results in the production of an animal of superior constitution and vigor, and therefore one which can profitably be grown for the market as beef, pork, or mutton. But such animals should always be disposed of in the market and never used as breeding animals.

CHAPTER XXIX

MANAGEMENT AND FEEDING OF SHEEP

MANY farms, by reason of topographical features, and many farmers, by reason of taste and temperament, are better adapted to the raising and care of sheep than of any other farm animal. Many hillsides that are almost inaccessible to most animals of the farm make good sheep pasture, and many farmers who are unable or unwilling to undertake the exacting duties connected with the dairy, turn to sheep farming for occupation and livelihood. It should not be inferred that sheep farming will permit of lax methods or irregular habits on the part of the farmer; such a course would as surely bring failure in this as in any other business.

PROFITABLE BREEDS

In the choice of breeds of sheep with which to establish the flock, the production of mutton should receive first consideration. It has been conclusively established that a pound of mutton can be produced more cheaply than a pound of beef under average farm conditions, leaving the value of the wool wholly out of consideration. This, of course, presupposes the use of some of the mutton breeds.

Within the memory of many farmers sheep farming was carried on primarily for wool production, mutton being only an accompanying incident; but within the last few years these conditions have been reversed, and mutton is now the main consideration, with wool as a side issue.

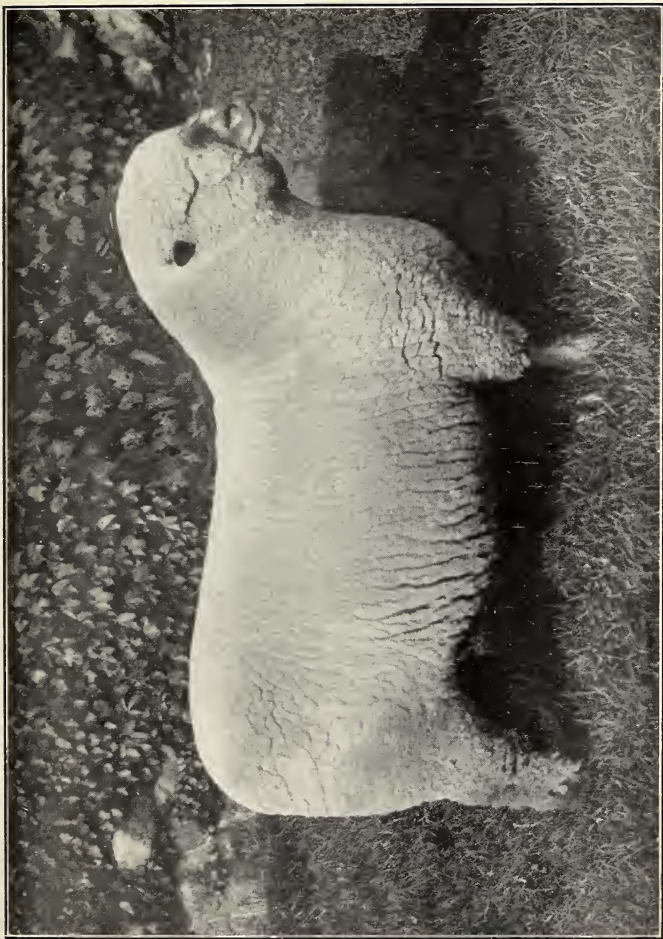
PURE-BRED SHEEP

The value of good blood has been demonstrated in many farm animals, and in none more than in the sheep. Not all of the animals belonging to any of the improved breeds are possessed of the same high degree of excellence. Individuals always differ more than breeds, and there are comparatively few perfect animals in any breed; but it would be strange indeed if all the practical, intelligent work put forth by both American and European breeders during the past hundred years had not resulted in material improvement in the mutton breeds of sheep, and it would seem to be the height of folly not to take advantage of such improvement when it is possible to secure the pure-bred stock.

Very careful experiments made by the various agricultural experiment stations have demonstrated the fact beyond question that pure-bred sheep will take on more fat within a given time, and at less cost, and will bring a higher price in market as mutton, than grade or scrub stock, and at the same time produce more wool of higher market value.

WHAT CONSTITUTES A GOOD SHEEP

There must be pronounced masculinity in the male and femininity in the female. They should show the sex as strongly as they do the breed which they represent. The male should be impressive and resolute; he is the head of the flock and he should look the part, be proud in bearing, with a bold, strong eye, wide face, and straight, robust body, impressing one with his splendid constitution and vital powers. The head should be carried on a round,



CHAMPION SHROPSHIRE RAM.
Owned by G. Howard Davidson, Millbrook, N.Y.

muscular neck, wide at the poll and gradually enlarging in all lines until it makes a strong, full junction with the shoulders. He should be wide of chest, prominent of brisket, wide of heart girth, giving him almost straight lines from shoulder to hips; straight back to root of the tail, broad and flat. Quarters full and well muscled down the flank and leg. Legs set wide apart and standing straight and strong.

THE FLEECE

It was once generally believed that a sheep such as above described was worthless for wool production; that it was necessary to raise one breed for wool, another for mutton, and a third for lambs. Thanks to the intelligent breeding of the past few years, all of these qualities and purposes are now combined in one animal. Some of the best mutton sheep are now producing the finest wool on the market, while their lambs are superior in every respect.

The fleece should feel compact and dense, insuring not only good wool, but protection to the body and good health in the animal. The wool should be carried well over the head and entirely cover the legs. The fiber should be fine, of good length and strong; yet it should be soft and pliable to the touch. Harshness in the fiber indicates a sheep of inferior breeding or one out of condition. In either case the market value of the wool is materially decreased.

THE SKIN

The skin of a well-bred, healthy sheep should be of clear pink or yellowish hue; a pale or blue skin indicates poor condition or poor breeding, and always yields an inferior fleece.

THE YOLK

The yolk is a skin secretion and is necessary for the production of a good fleece; but it should be clear and transparent, never discolored or gummy. The purpose of the yolk is to prevent breaking of the wool fiber and to promote the growth of the fleece.

CARE AND BREEDING OF EWES

Breeding ewes should never be crowded. Each requires at least ten square feet of floor space in the building in which they are housed, and from one and one half to two feet of feeding space at the feed rack. Crowding will often result in dead lambs. The coarse fodder may be fed in the yard, but the grain, roots, and silage should be fed in the feeding pen. Success in feeding breeding ewes will depend largely on the good judgment of the shepherd. If the ewes come from the pasture in the fall thin in flesh, more liberality in feeding will be necessary during the early winter in order to bring them up to the vigorous, firm condition desirable for the production of large, strong lambs.

FEED RATIONS

Ewes weighing 150 pounds require 2 pounds of either clover or alfalfa hay, 2 pounds of cut beets or turnips, and one half pound of bran and oats mixed per day. If neither clover nor alfalfa hay is present, the next best substitute as roughage is pea straw, cut corn fodder, oat hay, oat straw, or millet hay, which are valuable about in the order named. If roots are not procurable, then silage should be fed in order to supply some succulent

food; but the amount should not exceed 2 or 3 pounds per day per head.

As lambing time approaches, the grain ration should be gradually increased until one pound, or possibly a pound and a half, is being fed. Sheep do not like timothy hay and will not thrive well upon it, but they are fond of alfalfa, pea hay, and clover, especially alsike. Corn or corn meal should not be fed to breeding ewes, as it is too "heating," and produces too much fat.

FEEDING AFTER LAMBING

The chief purpose of feeding after the lambs are dropped should be to secure a large flow of milk. This result can best be obtained by feeding more grain, such as oats and bran, and all the roots and silage the animals will eat. The proper and quick development of the lambs depend largely upon the quantity of milk secured from the ewes. There is little danger of overfeeding while the ewe is suckling the lamb.

PASTURAGE

If the spring pasturage is good, it is usually not necessary to grain the ewes, but if it becomes dry or short, some grain will become necessary unless soiling crops of some kind have been provided. One of the best crops for summer feeding is rape. The sheep thoroughly enjoy it, and it produces an abundance of milk. Any of the clovers are valuable, and vetches are excellent for soiling purposes.

FEEDING THE LAMBS

The best lambs are raised by feeding them a little grain as soon as they are old enough to eat. The size of the

stock will thus be increased, and those intended for market will be in better condition and sooner supply the demand for early lambs.

The lambs should be provided with a separate pen, adjoining the ewes, so arranged that the bottom of the dividing partition lacks about a foot of coming to the floor. The lambs can then readily pass under the partition and enter their own pen. This pen should be furnished with shallow feeding boxes placed so low that the smallest lamb can readily eat from them; these should be kept scrupulously clean, always removing any grain that may be left after a feeding. Very little will be eaten at first, but the lambs should be fed as much as they will eat three times a day of the following mixture: equal parts of ground oats, bran, and oil meal.

One of the benefits resulting from feeding grain to young lambs is seen when the time comes to wean them. At that time the lambs accustomed to a grain ration will be weaned almost unconsciously and without checking their growth, while lambs reared without grain are usually checked in growth, and by worrying will reduce their condition in a noticeable degree.

FEEDING LAMBS INTENDED FOR BREEDING

Breeding stock should be grown, not fattened; hence, corn should not enter the ration. Whole oats are always desirable as the grain ration for lambs intended for breeding, provided some succulent food is also supplied, such as roots or silage.



MERINO RAM.

By courtesy of E. Peck and Sons, Geneva, Ill.

FEEDING LAMBS INTENDED FOR MARKET

A ration consisting of 4 parts bran, 4 parts corn meal, and 1 part oil meal, fed in such amounts as the lambs will eat clean three times a day, is the best fattening ration for market lambs, combined, of course, with plenty of clover, alfalfa, pea hay, or other easily eaten roughage and some kind of succulent food.

Other grain rations also may be fed to advantage, depending on the locality and the price of various grain commodities, such as cotton-seed meal, ground peas, wheat, etc., but corn seems to excel all other grain in laying fat on lambs and sheep.

The young rams should not be allowed to run with the ewes while fattening for market, as they will worry the ewes, giving them too much exercise.

Salt should be kept where it is at all times easily accessible to the sheep of all ages, and should be clean and pure. Pure water must also be supplied in unfailing quantity; failure in this regard will result in disaster all along the line.

TWINS

It is desirable in sheep farming to secure the largest possible number of lambs from a given number of ewes, for a properly fed ewe can supply milk for two lambs as well as for one, if the lambs are also fed a grain ration, as above suggested. It is therefore important that breeding ewes be secured which are likely to produce twins, as they are by far the most valuable for the purpose. It is a well-known law of nature that "like produces like"; hence, ewes being twins themselves, and whose ancestors

were twins, should be used in laying the foundation of the future flock. The chances of securing twins will also be doubled if the ram at the head of the flock and his ancestors were from twins.

SHEEP SCAB AND TICKS

It is impossible to fatten or even condition sheep while they are suffering from the disease known as scab. This ailment must be thoroughly eradicated without delay when found in the flock. Dipping is the only sure remedy, and any of the various dips on the market are effective, whether composed of lime and sulphur or tobacco compounds. Sheep should be dipped at least once a year for the purpose of eliminating ticks; otherwise they become troublesome and worry the animals.

CONCLUSION

In conclusion it may be said that the successful shepherd will provide his flock with plenty of good food, good water, sufficient room, light, dry, and well-ventilated shelter, and give good treatment. He will know not only every face in the flock, but the peculiarities of each individual, and be the friend and protector of every one.

CHAPTER XXX

PIG MANAGEMENT AND FEEDING

THE need of improvement in pig management among farmers is quite as great as in any other line of agriculture. By the farmer who has given the subject little thought, the hog is provided with a filthy pen where the wallow, bed, and feeding trough are equally neglected and vile. The animal is confined in a damp, dark, and ill-ventilated box, too small for exercise and too filthy for his health. He is fed slop, the refuse from house and farm, all of it decaying and unwholesome, and under these conditions is expected to make good pork.

It is scarcely necessary to say that such treatment is all wrong; that good pork cannot be produced in that way, and that, aside from failure to produce desirable meat, the practice is inhuman and cruel.

While the hog is a voracious feeder, no other animal responds more readily to wholesome feeding or brings better returns for good care.

The hog is not a ranger, nor does he thrive on grass alone. He cannot endure a great amount of travel at one time. Exercise he must have, yet he must be able to find his food with little effort, and water must always be accessible. During hot weather he craves a pool of water to reduce his temperature, for he perspires little. In winter he requires warmth and shelter.

To maintain good health and secure the best development, the hog should have access to growing clover, alfalfa, peas, beans, rape, or vetches in the summer, and should be fed regularly with cut roots, or silage during the winter months, besides such grain rations as can be most advantageously obtained.

HOG HOUSES

Hogs are sensitive animals, and are affected by extremes of heat and cold, and the character of the shelter should depend upon its locality. Warm and substantial structures are necessary in the northern parts of the country, while cheaper ones will suffice in more southerly climates; but under all conditions the requirements are the same, — warmth, sunlight, cleanliness, and ventilation.

The location of the house should be on a dry knoll if possible, so that good drainage from the building and yards may be secured. If it is to be a double house, it should be placed on a north and south line so that both sides may receive the sun during a part of the day. If it is to be a single house, with only one row of pens, the whole front should face the south, so as to secure all the sunlight possible. It should be borne in mind that sunlight is the great exterminator of germs, and is absolutely essential for the health of every animal.

HOW TO CONSTRUCT THE HOUSE

Whether the quarters are intended for one hog or fifty, the floor should be constructed of cement. It makes the only sanitary floor and about the only one that will withstand the rooting propensities of the hogs. The structure should be one story high, and need not be more than five

feet high at the eaves; the lower it is, the warmer it will be; but sufficient height must be given to provide for the necessary sunlight in every part of the pen.

Figure 18 shows an inexpensive and very convenient floor plan for a hog house, and may be extended in length to accommodate as many animals as desired. It is seldom wise to house more than fifty in one building. The pens are 8×16 feet inside measurement, and each is furnished with two doors and a window, one door opening into a driving alley and the other into the pasture or outside pens. The driving alley should be 8 feet wide and constructed of cement. This allows the use of a team and wagon in delivering feed, and cleaning the pens, while the animals may be loaded directly from the pens to the wagon for shipment.

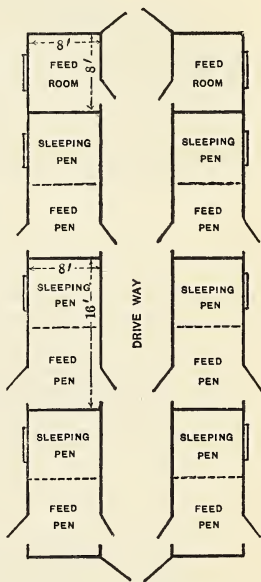


FIG. 18. Floor plan for hog house.

One half of each pen should be furnished with a false floor constructed of 2×4 inch timber, securely fastened to bottom cleats in such manner that half an inch space will be left between each of the timbers to provide for drainage. This false floor should be easily removable, so that it and the cement floor beneath may be cleaned.

Figure 19 shows the construction of the false floor, the

purpose of which is to provide a sleeping place for the animals which will always be dry. If this floor is pro-

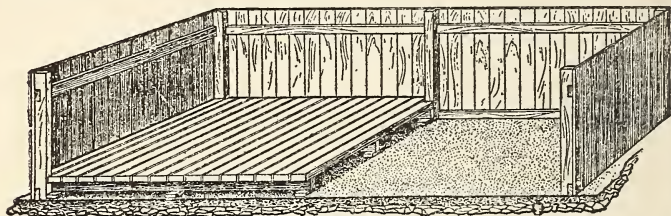


FIG. 19.

vided with a little straw, the hog will not foul his bed, and will always use it when lying down. In this regard he is quite different from, and much superior to, most farm

animals.

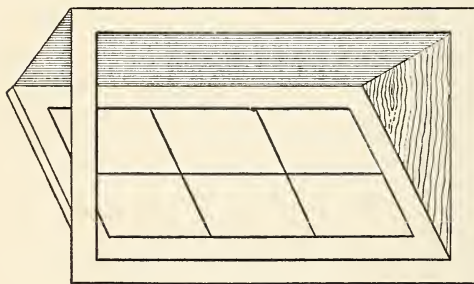


FIG. 20.

The windows should be hinged at the bottom and swing inward at an angle of 45° . Side or cheek pieces should be provided to prevent the air from coming in except upward and over the top

of the sash. Across the top of the cheek pieces should be tacked muslin cloth. Figure 20 shows the proper way to construct the windows in a hog house. This method will

prevent direct drafts from striking the animals, will admit plenty of air, and still maintain warmth in the pen.

PORTABLE HOG HOUSES

In case of an epidemic of hog cholera or other disease, it may become imperative to isolate certain affected animals. This cannot be done in cold weather in the absence of some shelter designed for that purpose. Some breeders who maintain large herds believe that the system of many small houses is preferable to one large house in many respects. They contend that epidemic diseases are not likely to destroy many animals in a herd if they are well separated and only a very few kept in one place; that the house and animals may be easily removed from place to place and the land plowed and seeded to crops, and that the small house may be set down where the pasturage is fresh and surroundings clean. They believe that farrowing sows kept in such houses bring better and stronger litters and rear them more successfully.

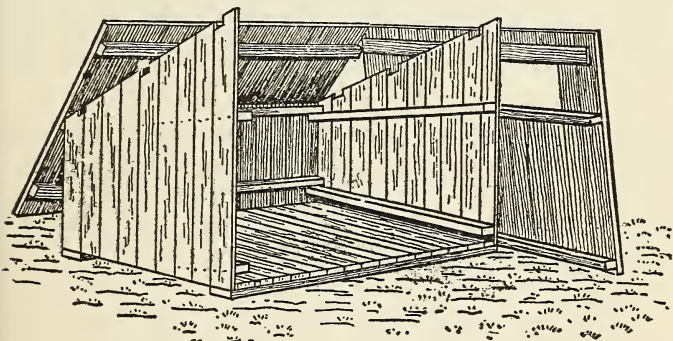


FIG. 21.

Such houses are cheaply constructed, can be taken apart and moved about with little trouble, as they are usually only 6 or 8 feet square and 3 feet high at the lowest part. Figure 21 shows the style of construction of one kind of portable house.

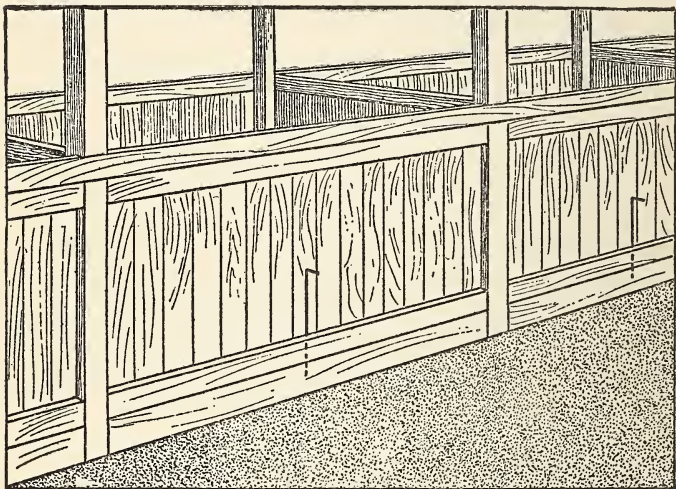


FIG. 22. Front closed.

However, many very successful breeders contend that the extra labor in feeding and caring for a large number of hogs scattered about the farm in small houses is too costly, rendering the business unprofitable; that the hog house should be convenient, sanitary, and advantageously situated.

A very convenient arrangement for feeding where only one large house is used is provided by having swinging

fronts so constructed that the feed can be placed in the troughs and evenly distributed before the hogs can get at it. The gates of the feeding pens are the same length as the troughs and solidly built. The gate is hung on hinges at the top, and attached to it is a strong iron rod

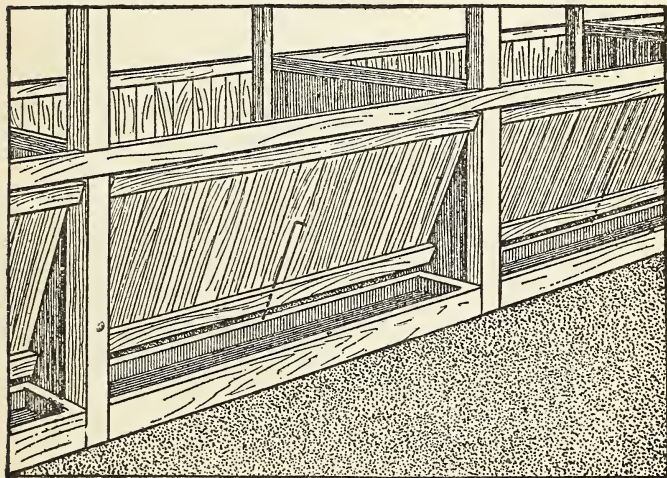


FIG. 23. Front open.

which fits into a hole in the farther edge of the trough, holding the gate open until the rod is pulled up and the gate closed, when the rod is inserted into a hole in the sill at the front of the pen and the front securely closed. Figure 22 shows such a pen with the front closed, and figure 23 shows the same pen with the front open and ready for the feed.

TROUGHES

The old wooden V-shaped trough is familiar to all, but iron troughs are in every way the most satisfactory. They are sanitary, easily cleaned, and with care will last indefinitely.

PASTURES

The question of pasture both as to size and location must be determined by the surrounding conditions. The larger the pasture, the more exercise the animals will be likely to get, and usually the more green forage.

FENCES

There is no more intolerable nuisance about a farm than a loose hog, a fact which demands proper fencing. Woven wire 3 feet high makes a good hog fence when attached to strong posts. If it is necessary to keep other animals out, one or two strands of barbed wire stretched at intervals of a foot on the upper part of the posts will serve the purpose.

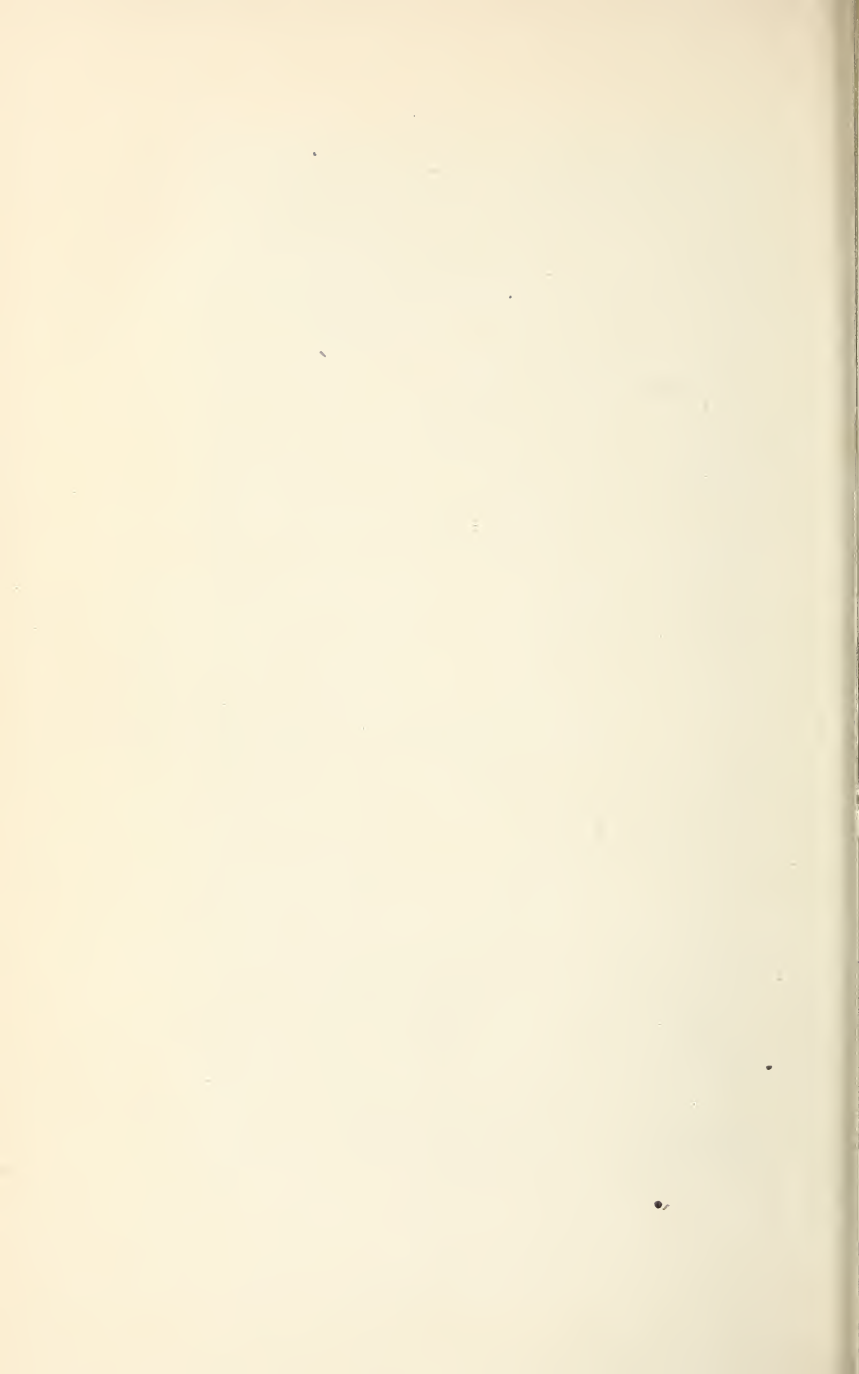
SELECTING THE FOUNDATION STOCK

The farmer who desires to become a breeder of hogs, but who has had little or no experience in that line, should go slowly. The start should be made with a few first-class animals, not more than five or six, and under many circumstances one would be better. It would be much wiser to purchase one really first-class sow in pig to a first-class boar than to purchase several second-class ones for the same amount of money. In this way the purchase of the boar could be deferred for nearly a year, when he could be used to serve both the sow and the



HAMPSHIRE HOGS.

By courtesy of Price and Hills, Richland Farm, Randor, Ohio.



young females of her first litter after they became properly developed.

POINTS OF A GOOD SOW

The best age at which to purchase a breeding sow is one year old. The forehead should be broad and the eyes wide apart, the neck moderately thin, the shoulders smooth and deep, the back wide and straight, the chest deep and broad, with well-sprung ribs, straight, deep sides, and a long body showing great capacity from end to end. She should have twelve well-developed teats, broad and roomy pelvic cavity to insure easy parturition and ability to properly nourish a large litter. She should stand on short, straight legs, and always well up on the toes. One of the signs of inferior animals is the sagging down of the leg at the pastern joint. This defect should prevent the purchase of the animal for breeding purposes, as the trouble is liable to become serious when the sow is heavy with pigs, and is almost certain to render a boar useless, as the hind pastern is more seriously affected and will eventually break down entirely. The sow should be descended from a prolific, uniform family of good digestive capacity, early maturing and easy to fatten.

SELECTING THE BOAR

It is said that the boar is half of the whole herd, and when it is remembered that he is the sire of every pig in the herd, and that they are likely to be good or bad largely according to the quality of the sire, the breeder cannot afford to exercise less care in his selection than in that of the breeding sows.

POINTS OF A GOOD BOAR

The character of the boar selected should be governed by the character of the sows to be bred. If they are fine of bone, skin, and hair, the boar should be "rangy," strong-boned, and masculine. If the sows are inclined to be coarse, then the boar should be fine-boned, thin-skinned, and show high quality, thus tending to correct in the offspring the defects of the sows.

A good boar should have a masculine head and well-crested neck when fully developed, and the same indications of a good pork-producing carcass described for a good sow, and he should stand up on his toes.

FEEDING

In the summer season every animal, regardless of sex, should have access to a field containing clover, alfalfa, peas, beans, rape, vetch, grass, or some green crop. The hog's system requires it, and successful breeding and management demand it. In the winter they require some succulent food, such as roots or silage, and also some food having bulk, like alfalfa or clover hay or corn fodder.

Every animal should have free access to charcoal, ashes, and salt. The grain ration for breeding sows may consist of bran, oats, peas, beans, barley, rye, or wheat, excluding corn, and a sufficient quantity should be fed to keep them not fat but in good condition, giving them a little exercise every day. If the pens are so situated that they are compelled to go down a hill to get water, they will thus get sufficient exercise, or they may be driven about for the purpose.

FARROWING TIME

A week before a sow is expected to farrow she should be placed in a pen by herself and be well bedded with straw or fine chaff. The sides of the pen should be provided with a rail or fender to prevent her from lying upon and crushing the young pigs.

After the litter is farrowed, the sow will usually lie with her back to the side of the pen, between which and her back the little pigs will inevitably try to crawl and be crushed. Figure 24 shows the construction of a feeder which will prevent the sow from lying so close to the wall as to injure the pigs.

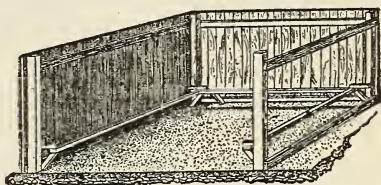


FIG. 24.

If farrowing takes place in cold weather, care must be taken that the pigs do not get chilled, and it may be necessary to warm the house slightly for a time.

THE PIGS

The pigs should be allowed to get upon the ground and in the sun as soon as the weather will permit. When three weeks old, they will begin to require food in addition to the sow's milk. If they are fed a little skim milk or a thin gruel of oatmeal in a low trough which they can easily reach, they will immediately begin to grow and thrive.

A pen should be arranged adjoining the one occupied by the sow and separated from it by a partition raised

from the floor sufficiently to permit the pigs to run under it at will. In this pen the pigs can be fed until they are large enough to wean. Figure 25 shows the detail of such a pen.

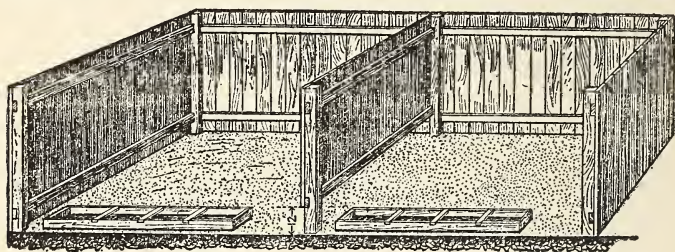


FIG. 25. Showing raised partition for pigs.

Ground oats should not be fed to young pigs, as they cannot digest the woody matter contained in the grain. As they learn to eat, a variety of feeding stuffs may be used, always in a liquid form, and the ration can be increased with age. They should never be fed quite as much as they can eat, as the purpose at this stage is growth and not fattening. The trough should, of course, be kept clean, and no stale feed allowed to remain in it.

If the pigs have been properly fed, they may be weaned at the age of twelve weeks, and weaning may be accomplished almost without their knowledge if they are feeding well and growing. After weaning, those selected for breeding animals should be separated from those intended for market.

The breeding stock should be fed a ration especially adapted to produce growth, while the market animals should be fed a more fattening ration. The stock selected

for breeding should also have a large range and plenty of exercise, so that they may develop strong and thrifty. If properly grown, they may be served for breeding at eight months old and produce a litter at one year old.

The market pigs should be fed to the limit of their capacity and allowed only sufficient exercise to keep them in health. The ration should consist of a variety of mill feeds, and corn should be used to a considerable extent. Dairy products, such as skim milk and whey, may be used to good advantage in connection with grains. Some

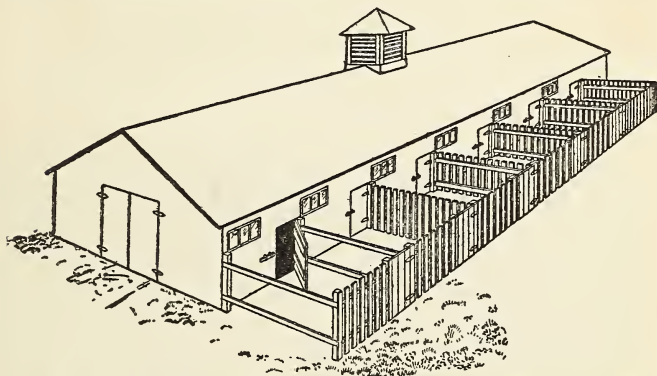


FIG. 26. A convenient, sanitary, and inexpensive hog house.

succulent food, such as green clover, alfalfa, or roots should always be included.

The most profitable time to feed pigs is when they are young — under ten months. The daily gain should then be from one pound to one and a half pounds, and when ten months old the pig should weigh 250 pounds. After that age gain in weight is much more costly, and it is

doubtful if, at present market prices, it pays to feed older animals for production of pork.

VERMIN

Hogs frequently suffer from lice, and when so afflicted, cannot be properly or economically fattened. The lice will usually be found just back of the ears and in the folds of the skin, also on the insides of the legs; in such cases the animal should be treated to the wash described in Chapter XXXIII, headed "Some Practical Suggestions."



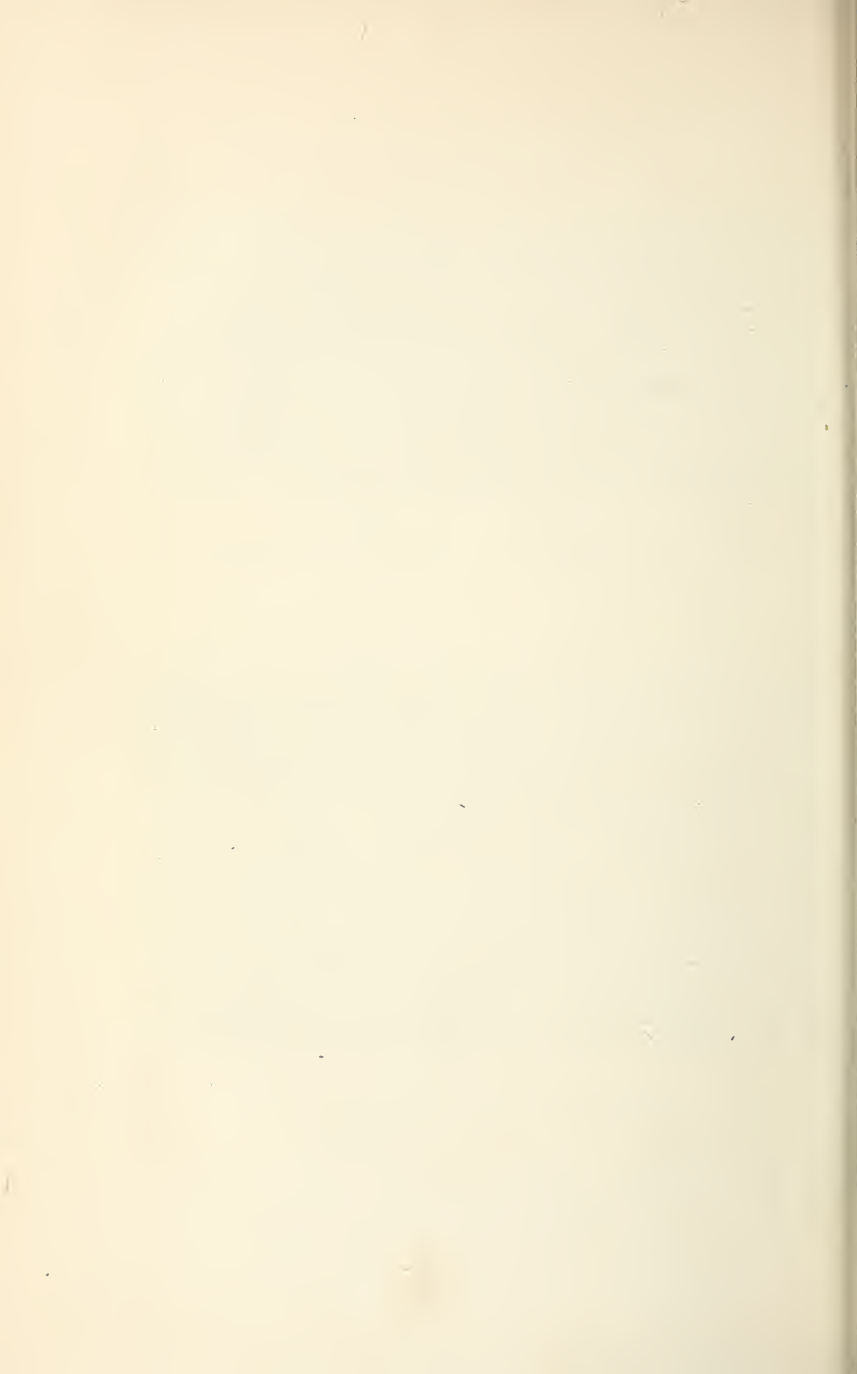
GRAND CHAMPION BERKSHIRES.

By courtesy Iowa College of Agriculture.



Imp. LARGE YORKSHIRES.

By courtesy W. H. Fisher, Columbus, Ohio.



CHAPTER XXXI

POULTRY ON THE FARM

Tons of literature have been printed, hundreds of thousands of dollars invested, and untold labor and effort wasted upon the subject of poultry, and still the actual results are little more than negative. Most of us can recall many instances of the enthusiastic poultry fancier recruited from the shops, the office, and even the professions in the city, establishing himself upon a poultry farm in our neighborhood. He came full of literature on the subject, built elaborate houses, runs, brooders, and incubators, purchased high-priced eggs and costly fowls. He could figure out a comfortable living for himself and family, with freedom from city cares. He usually remained two years; the feed bills exceeded the receipts for eggs; the roup got his hens and lice got his chickens; his enthusiasm waned and he went back to his counter. It is a dismal fact that nine out of every ten who enter upon the poultry business make a failure of it.

The fact is that the literature upon this subject at the present time is largely theoretical; correct perhaps in principle, but lacking in practical application. To illustrate: there is no reason in theory why eggs should not hatch in an incubator where the warmth, ventilation, and sanitary conditions are better than a hen can supply;

but in practice they don't. From 50 to 75 per cent, if hatched, is considered a good result, while the old hen would hatch them all.

In theory the brooder ought to be more sanitary, furnish more room, and be quite as successful and comfortable in mothering chicks as a hen, and yet the chickens persist in dying by scores. Something must be wrong in theory, and probably much is amiss in practice.

While there are very many successful poultrymen throughout the country, they are only the exceptions to the rule, and it is very doubtful if the ordinary farmer can materially increase his poultry plant beyond a limited extent with assurance of success and profit.

There is no doubt that poultry on the farm pay and pay well. They require little attention, they obtain most of their own feed during summer, and secure much of their winter ration from the waste material about the barn. All this is simple if the number is small, but let the number be increased to 200 or more, and trouble at once begins. Roup and vermin attack the chickens, blackhead the turkeys, rickets the ducks, and "going light" the pigeons. Confine 200 of either variety of these birds for a year, according to theory, and see what will happen.

The truth is that we have still much to learn on the subject, and it must be learned by practical experience on the farm. There is large room for improvement on every farm, and in no direction more than in present methods of caring for barnyard fowls. Better shelter, better feed, and more careful attention would undoubtedly secure better results, but for the present, at least, it is wiser to

let the enthusiast experiment with poultry as a business, while the farmer attends to his dairy and his crops.

A few suggestions may be timely even to the farmer who keeps only a few fowls, and up to a certain number he is urged to increase his flock.

THE KIND OF FOWLS TO KEEP

For the farmer who has no particular interest in the subject except to have a few eggs for family use, the ordinary mongrel fowl will serve his purpose best, because such birds will stand neglect better than those more highly bred, and are able to live and thrive under unfavorable conditions and "rustle" for themselves. They are generally hardy, and yield a fair return in eggs and table food.

PURE-BRED FOWLS

Probably the most popular general-purpose fowls are the Plymouth Rocks and the Wyandottes. They are good egg producers, good table fowls, and good sitters. They also take good care of their young. They may be too good sitters for the farmer who especially desires a large return in eggs. In that case he should obtain some of the Mediterranean breeds, such as the Leghorns or Minorcas. These are smaller fowls, but are great foragers, and spend little time in sitting. If, on the other hand, he desires a very heavy fowl, he should turn to the Asiatic breeds, such as the Brahmas, Cochins, or Langshans.

It may be recorded as a general proposition that the larger and heavier the breed, the more likely they will be to brood and sit. The poultry business, like bee keeping, must, in order to be successful on a large scale, be highly

specialized and receive the undivided attention of some person whose tastes are fitted to the work. Such attention the farmer is seldom able to give, and the old method of rearing his chickens by the aid of the sitting hen will appeal to him until such time as the artificial method becomes more simple and satisfactory.

PART III

CHAPTER XXXII

THE FARM ORCHARD

It is not the purpose of the writer of these pages to encroach upon the domain of the horticulturist nor to enter upon a discussion of the vexing questions so frequently debated by the orchardist. Horticulture is a distinct science, and occupies a department in agriculture quite separate from farming as that term is commonly understood, while the business of producing fruit for market upon a large scale comes within the province of the orchardist, and is quite beyond the reach of the ordinary farmer.

Every farmer, however, should own a fruit lot and know how to care for it. He should know how to select the best site for his orchard, the trees best suited to his locality, how to properly set them out, prune, trim, and graft, and how to protect them from disease and insect enemies.

The purpose of the farm orchard is very different from that of the commercial orchard; hence different consideration should be given to the selection of varieties in planting, and simpler and less costly modes of treatment practiced. It is true, nevertheless, that the same enemies, both fungus and insect, attack trees in whatever orchard they are

grown, and what applies as proper treatment in one case will generally hold good in the other.

It may be said at the outset that the fruit orchard will not "live by faith alone." It requires watchful, intelligent care and considerable industry to maintain the farm orchard in first-class condition. While this is true, there are few things that bring better returns or give greater satisfaction for the labor bestowed. The farm without its fruit orchard is like pancakes without maple sirup — possible but not enjoyable. The farm orchard should supply the family and friends with the cheapest and most enjoyable fruit the year through, as well as many dainty dishes the housewife knows so well how to prepare.

THE LOCATION

The foremost orchard fruit to be considered is, of course, the apple, which, in common with such other fruit as the farmer is likely to produce, requires a deep, well-drained soil. Apples, and especially stone fruit, will not thrive in damp soil; therefore a site should be selected for the orchard that is rich in plant food, with good natural drainage, and as conveniently located with reference to the dwelling as possible. A gently sloping side hill is preferable, and if it is a little stony, so much the better. It may not till so easily, but the fruit will grow better.

VARIETIES

The commercial orchardist confines himself to very few varieties, usually three or four, and seldom more than five, which are best adapted to his location and markets; but the farmer requires many varieties if his orchard is to

supply the demands of varied tastes and furnish palatable fruit throughout the year. Early summer fruit, late summer and fall fruit, early winter as well as late winter and spring fruit, all are necessary for his table. Sweet apples, as well as sour and medium, must be found in his orchard, besides the russet and the crab. There are many hundreds of varieties from which to choose, but the selection should be made with reference to the adaptability of the varieties to the climate and soil of any given locality. In this matter, advantage should always be taken of the experience of others under similar conditions. Personal taste should also be considered, as most people will give better and more willing care to things of which they are fond, and therefore the varieties will be most likely to succeed which are most pleasing to the owner and his family.

While it is impossible to give much information regarding the selection of varieties because of the wide diversity of tastes, a few of the standard varieties are named which seem to have established themselves in certain localities because of climatic adaptability and market popularity. The Ben Davis, Jonathan, Grimes, and Red Astrachan will thrive in almost any State in the Union, while the Baldwin is the leading apple in New York State, and is also popular throughout New England. After the Baldwin in New York comes the Rhode Island Greening, the Spy, Ben Davis, Fall Pippin, Wealthy, and others.

Maine, New Hampshire, and Vermont grow the apples that are most popular in New York, and besides them such varieties as McIntosh and Gravenstein are common; while Massachusetts has made popular an additional early variety called Williams Favorite.

Connecticut and Rhode Island favor the Baldwin, Ben Davis, Wealthy, McIntosh, Duchess, and Rome Beauty, while New Jersey supplies the early New York markets with such varieties as the Carolina Red, Early Harvest, Yellow Transparent, and Red Astrachan, and the later markets with the York Imperial, Ben Davis, and Smith Cider.

The most popular apples in Delaware and Maryland are the early varieties, such as Early Strawberry, Early Ripe, Williams Favorite, Fourth of July, Yellow Transparent, and Red Astrachan.

The principal market varieties grown in Pennsylvania and West Virginia are the Baldwin, Winesap, York Imperial, Wealthy, Jonathan, Grimes, Rome Beauty, Gano, and Mammoth Black Twig. Virginia is the home of the famous Albermarle Pippin.

The higher altitudes of North and South Carolina, as well as Georgia, produce the Ben Davis, Gano, Yates, Shockley, Grimes, Rome Beauty, and York Imperial, besides some early varieties, such as the Red Astrachan, Carolina Red, Yellow Transparent, and Early Harvest.

Michigan furnishes largely the same varieties grown in New York and New England.

Colorado, Kansas, and Oklahoma succeed with the Ben Davis, Missouri Pippin, Winesap, Jonathan, Grimes, Rome Beauty, and Wealthy, all of which also thrive in Arkansas and southern Missouri, except that the Paragon and the Mammoth Black Twig are largely substituted for the Wealthy and York Imperial.

In Iowa, Nebraska, and northern Missouri the Ben Davis, Gano, Missouri Pippin, Duchess, Grimes, North-

western Greening, and Jonathan are successfully grown, while in Kentucky and Tennessee the Ben Davis, Gano, Winesap, Grimes, Jonathan, Paragon, and several early varieties are the favorites.

The principal varieties grown in Indiana and Illinois are the Ben Davis, Jonathan, Gano, Winesap, Willow Twig, Rome Beauty, Benoni, Wealthy, Duchess, and Yellow Transparent, while Wisconsin, Minnesota, and South Dakota favor the Wealthy, Duchess, Northwestern Greening, Patten Greening, and Malinda.

Montana can produce fine crops of the Duchess, Wealthy, Alexander, McIntosh, and Wagener apples, while Texas grows almost all of the varieties for Northern shipment.

Oregon claims to be the ideal apple-growing State of the Union, and certainly in size, perfection of coloring, and beauty her apples have no superior. In fact, many localities on the Pacific coast, from British Columbia to California, produce very beautiful fruit, the leading varieties being the Yellow Newtown, Esopus, Spitzenberg, Jonathan, Arkansas Black, and Winesap. It has been said, however, regarding the Pacific coast apple that its beauty is "only skin deep," and that the flavor is not equal to that of fruit grown in colder localities.

In the Province of Ontario very choice fruit is grown from such varieties as the Baldwin, Rhode Island Greening, Spy, Roxbury, Ben Davis, Stark, Alex McNeil, and various other varieties, while the Province of Quebec is the home of the Fameuse, which, according to the writer's taste, is the most delicious apple grown. It deserves all the fame its name implies, and in all that

region it has no equal. The Fameuse of Quebec and the Montreal melon have helped to make Canada famous, and the tourist in that region cannot afford to fail in properly testing each.

A glance at the foregoing list of varieties of apples cannot fail to impress the reader with one fact, to wit, that the Ben Davis is at home wherever found, and therefore a safe variety to plant in any orchard.

EXPOSURES

Much has been said and written on the subject of the proper exposure for orchards, but the whole subject may be summed up in a sentence: Any exposure is a good one if all other conditions are right. The old adage to the effect that a fine horse always has a good color applies to orchards, for it may be said that every good orchard has a good exposure.

SECURING THE TREES

Much valuable advice has been given on the subject of how to select the right kind of stock. We are told that only such trees should be selected as are grown in the locality of the proposed orchard; but how can the purchaser know where such trees are grown? Again, we are sagely told that all stock should be carefully inspected, before being planted, for signs of San José scale, black spot, canker, etc.; but how is the farmer to detect the trouble if he doesn't know what San José scale is?

All this is good advice for the professional orchardist, but the practical thing for the farmer to do is to order such varieties of young trees as he may decide upon from a thoroughly reliable and reputable nurseryman, and the

chances are that he will get better stock than he would if he selected the trees himself.

SIZE OF TREES

Usually the best results are obtained by using trees about two years old, and while they should be well grown, it is not essential that the largest trees should be selected. Neither is it very important that they should have large heads and extensive root systems, for the heads should nearly all be cut away when planting in any case, and it is now known that neither the large roots nor fibers ever grow after planting, but that new shoots must start before the tree begins to grow. The main point to observe is, whether the young tree looks thrifty. If it does, plant it.

HOW TO PLANT

Perhaps no other subject has received more attention among fruit growers than that of the proper way to plant trees, and it has been argued from every standpoint all along the line. Some hold that young trees should be planted in the same condition, as nearly as possible, as nature produced them, even to maintaining all of the tops and carefully spreading the roots and setting the tree in the same direction which it formerly occupied with reference to the points of the compass. Others claim that the best results are obtained when all of the branches are cut off clean and most of the stalk also, as well as all of the roots. They plant trees using only one tool — the crowbar.

Between such extremes there is always some middle ground which common sense will lead to, and so it is that if the head is cut so that about three limbs are left, which

will eventually make a well-balanced top, and these are cut back so that three or four buds remain, the tree will be likely to live and have a well-formed top. The roots should be shortened to five or six inches, and all broken parts removed.

DISTANCE APART

The ordinary apple tree, when full grown, requires 35 to 40 feet between rows, and if the orchard is of considerable size, the rows should be straight.

INTERTILLAGE

It will at once occur to the thrifty farmer that such wide rows involve waste room, especially while the orchard is young and not yielding fruit, unless some kind of crop can be grown between the rows. The orchardists tell us that this should not be done; but, like many other things, it all depends on circumstances. If the land is rich, and the season not too dry, a crop of well-tilled potatoes or beets will improve rather than injure the condition of the trees. Corn will probably shade the young trees too much and be likely to remove too much moisture from the land. A quick-growing soiling crop like rye, or oats and peas, will not interfere much with the trees, if a good coat of manure is applied and plowed under after the crop is removed.

If the orchard is seeded to clover, and the part which it is necessary to cut around the trees with the scythe is raked up and placed about the young trees for a mulch, and the rest of the crop taken to the barn for hay, the trees will not suffer.

Of course at least one good crop of clover should be plowed under every three years, unless plenty of barn-

yard manure is available. In short, there has been a vast amount of nonsense written about the care of the soil where young trees are growing, but it all comes to this: if the area occupied by the roots of the young trees is supplied with all the plant food required by the trees, and proper means are taken to conserve the natural moisture, the rest of the space between the rows may be producing profitable crops and the trees will be in no wise injured.

Some expert fruit growers recommend the planting of some quick-growing and early-bearing trees, such as cherries, plums, or peaches, between the rows of apple trees, and when the apple trees come into bearing the removal of the interplanted trees. It is a little difficult to understand the force of this philosophy, because if tilled crops between the rows of apple trees are injurious, why not the crop of quick-growing trees? Certainly the difficulty in properly tilling the orchard will be increased by planting additional rows of trees, and the writer can foresee several serious arguments to be settled with the stumps of those interplanted trees before a proper state of tillage is again secured.

Strawberries make a fine crop to fill the spaces between orchard rows. In fact, almost any garden crop can be profitably and properly grown in the young orchard.

CULTIVATION OF THE BEARING ORCHARD

If the young orchard has been tilled as suggested above, it will be easy to continue proper tillage when the trees are grown. At this stage it is entirely proper for the farmer to take the advice of the orchardist, not to crop the land between the rows. There are two sensible reasons

for this, the first of which is that the trees require all the available plant food and moisture which the soil affords; and second, nothing would grow there, anyway, on account of the shade. It therefore comes down to the simple question how best to till the orchard.

It should be plowed in the spring as early as good plowing can be done, and properly and frequently harrowed so as to conserve moisture. Such tillage should continue till midsummer, and then cease. If a cover crop is desired, it would be wise to sow rye or crimson clover at the last tillage, if that occurs as late as August 1; but other clovers should be sown from the latter part of June to the middle of July.

The fact is realized that a suggestion from the writer to seed the orchard for pasture is rank heresy, and yet the farm orchard is not planted primarily for profit, but for convenience and pleasure as well as utility, and who can forget the splendid spreading trees, the clean, firm, well-cropped carpet of grass on which the yellow apples looked like globes of gold. What a place to while away the afternoon in this paradise of the farm!

PRUNING

The question of pruning the young orchard — when, how — is a subject upon which practical orchardists fail to agree, and therefore the farmer may be pardoned if he exercises his own judgment and consults his own taste in the matter. If it is more convenient to prune in the winter than at any other season, then winter pruning for him is the best; but spring or midsummer is also a proper time if the work was not done in the winter.

LOW HEADS *vs.* HIGH HEADS

Generally low-headed trees are more easily cared for than high-headed ones, and this is particularly true with reference to the labor of trimming and spraying the trees when grown, and in picking the fruit. On the other hand, high trees favor easy cultivation because the limbs are usually out of the way, and if a farmer should commit the sin of pasturing his orchard, the fruit will, as a rule, be high enough to be out of harm's way if the trees are allowed to head high. Whichever plan is adopted, all ill-shaped and crowding limbs should be cut out and the head thinned so as to freely admit plenty of sunlight and air.

All cutting should be done as closely to the main branch or trunk as possible, and no stubs left, so that the wound may be readily healed.

IMPROVING THE OLD ORCHARD

Many farms contain old orchards which fail to produce fruit and which have been so long neglected that they are practically useless. Such orchards may or may not be worth attention; it all depends upon the condition of the old trees. If from any cause half of the trees are dead, missing, or broken, it will not pay to maintain the orchard as such; but if the trees are not too old, and most of them are in place, it will probably be wise to renovate the orchard. For this purpose the first thing to do is to cut out the dead and diseased limbs and burn them. Some of the high tops should also be cut out so that the sunlight and air can find access to all branches. The old, rough

bark should be scraped from both the trunk and limbs, thus removing the dwelling place of many fungus and insect pests. This refuse bark should be burned. The land should be plowed and well tilled and plenty of barnyard manure applied. Then the trees should be thoroughly and regularly sprayed, as recommended under the heading of spraying.

The next year in March more branches should be cut out, and this trimming should be continued every year until the tree is properly thinned and properly shaped. It is better to trim out old trees gradually than to overdo the work at the start. The result of this course will be fewer water sprouts to contend with, and the tree will become gradually accustomed to the new conditions. All large cuts should be painted with white lead.

GRAFTING

It is frequently found desirable to regraft fruit trees after they have come into bearing. A strong, vigorous tree may produce worthless fruit, or the farmer may desire to grow some variety not planted in his orchard. Grafting may be successfully performed when the trees are in a healthy condition and not too old. In other words, if the tree has lost its vitality through age, disease, or neglect, it will not pay to graft. Grafting should be done only when the tree is dormant, and the process is about as follows:—

Secure a number of small, dormant twigs or scions from a tree of the variety desired. Cut off the stock or limb to be grafted at the point where the scion is to be placed, using a fine-tooth saw. Split the stock downward and

cut the scion in the form of a long, slender wedge, and insert it firmly into the cleft in the stock in such a manner that the bark of both scion and stock shall come firmly together, using care that the bark of neither is loosened or injured.

The end of the stock and scion should then be covered with grafting wax so thoroughly that the whole joint will be air-tight.

If the stock is a large one, two scions may be placed on the same stock, one at each extremity of the cleft, and if both grow, one should be cut out later.

If the whole tree is to be regrafted, it should not all be done at once, but should occupy at least three years, if the tree is in bearing. The first year perhaps a third of the branches may be cut and grafted, mostly from the top and center. The second year another third may be treated, and the third year the work can be finished.

GRAFTING WAX

It has been found that the best wax to use in grafting is made as follows: Melt resin 4 parts, beeswax $1\frac{1}{2}$ parts, linseed oil 1 part, and apply while melted to the grafted stock.

SPRAYING THE ORCHARD

There are so many enemies to contend with in the growing of fruit that it is not surprising that the farmer often becomes discouraged and neglects his orchard, and a very few years of neglect are usually enough to destroy the finest orchard. Orchard pests multiply with amazing rapidity, and the neglected orchard soon becomes not only unprofitable to the owner, but a center for the dissemina-

tion of evil broods of fungus diseases and insect pests throughout the neighborhood.

There is abundant evidence that these enemies may be controlled and many of them finally exterminated from the orchard by the proper application of spray mixtures, and in his own interest, as well as in justice to his neighbor's, it would seem to be desirable that every farmer should spray his orchard. All the time and money spent in planting, pruning, grafting, and cultivating the orchard, either by the farmer himself or by those who preceded him, is practically wasted if the orchard is not properly sprayed.

There are many different kinds of sprays in use and various formulas upon the market, many of them effective and some worthless; but there are two mixtures which at the present time are recognized as standard and worthy of general use, at least until something better is discovered.

THE LIME-SULPHUR-CAUSTIC-SODA SPRAY — FORMULA

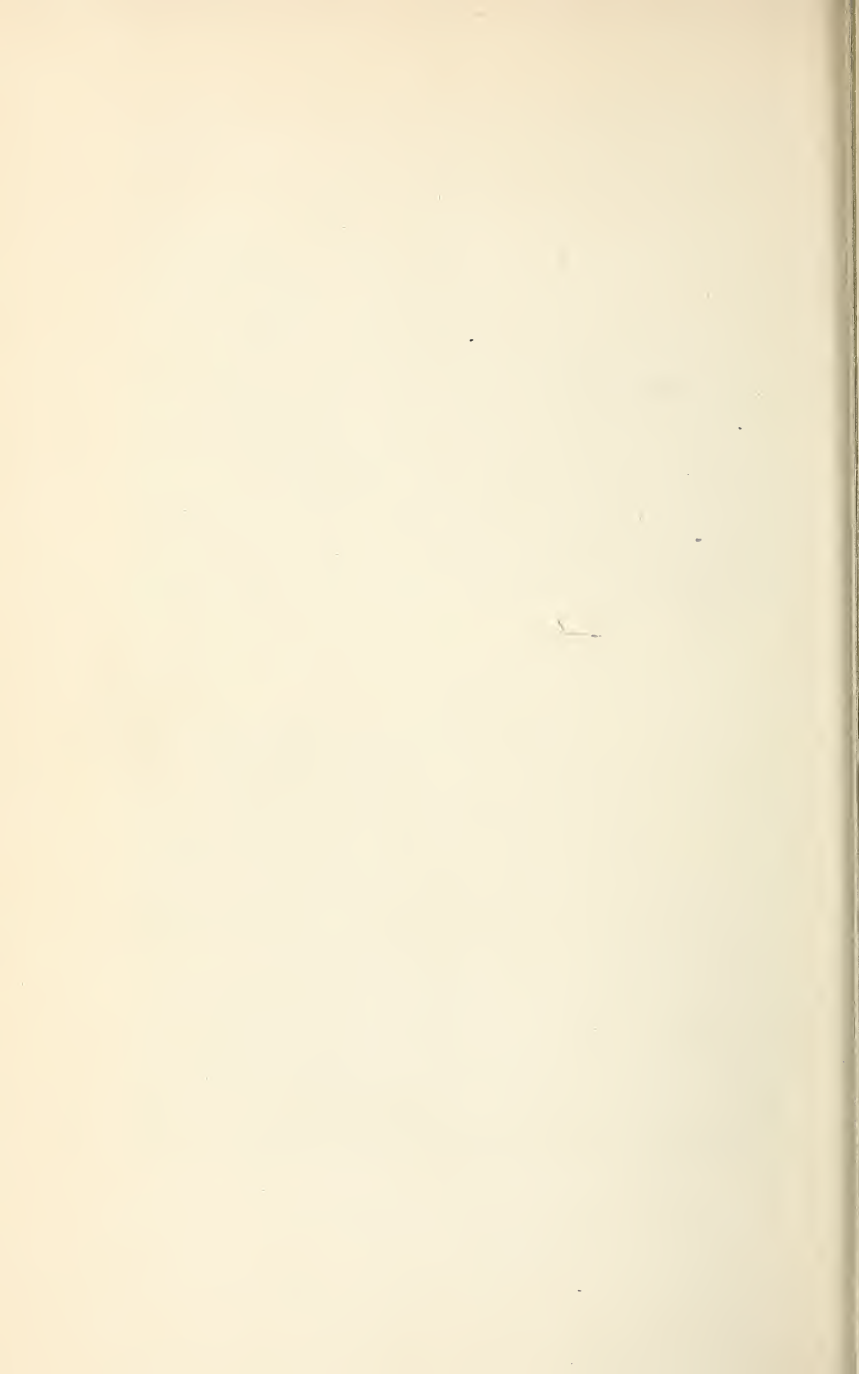
Lime	30 lbs.
Sulphur	15 lbs.
Caustic soda	5 lbs.
Water.	50 gals.

To prepare this mixture, place good, clean, unslaked lump lime of the required quantity in a tub and add hot water enough to start the slaking of the lime. As the slaking proceeds, more water should be added to prevent air-slaking, but not enough to drown it. As soon as the boiling process begins, add the sulphur, which has just previously been made into a paste with water. Stir this in thoroughly and pour in water in small quantities in order to keep the mixture in the form of a thin paste.



Result of spraying peach trees with lime-sulphur wash. Showing prevention of leaf curl. Trees in upper figure unsprayed. Trees in lower figure sprayed.

By courtesy New York Agricultural Experiment Station, Geneva, N. Y.



After the lime is slaked, add the caustic soda at short intervals in quantities of about 2 pounds each, and stir constantly until the soda is dissolved. As soon as the chemical action has ceased, dilute the mixture with cold water to make the required amount.

The whole mixture should be strained through a fine sieve or cheese cloth to remove all sediment and dirt which otherwise would clog the nozzles of the sprayer.

WHEN TO APPLY THE LIME-SULPHUR-SODA SPRAY

The proper time to apply this spray is when the trees are dormant, generally in March, and every part of the tree should be "hit." If the condition of the wind is such that only one side of the tree can be sprayed, the other side should be sprayed as soon as the wind changes to the proper direction.

The trees should be dry when the spray is applied, and if rain falls soon after spraying, it may be necessary to go over the work a second time.

This mixture has been found very effective in destroying many fungus diseases and the larvæ of insects which winter under the coarse bark of the trunk and limbs.

THE BORDEAUX-ARSENICAL MIXTURE

Copper sulphate	5 lbs.
Quicklime	5 lbs.
Paris green	$\frac{1}{2}$ lb.
Water	50 gals.

This mixture is prepared as follows: Slake the lime exactly as in making the lime-sulphur-caustic soda mixture,

and add water in sufficient quantity to make a thin paste, or good whitewash, and strain it through a fine sieve. Dissolve the copper sulphate in a pail of warm water by suspending a small bag containing the copper sulphate in the top of the water. When it is entirely dissolved, pour at the same time into the tank containing the proper quantity of water both the dissolved copper sulphate and the slaked lime. Pour both in slowly and mix thoroughly while pouring in. The Paris green may then be added by putting it in dry and thoroughly mixing it in. The whole is now ready for use.

USE OF THE BORDEAUX-ARSENICAL SPRAY

This mixture should be applied first, just before the buds begin to open in the spring, when the tips show green. A second application should be given as soon as the blossoms have fallen, and a third application about two weeks after the second. Each application should be thorough, when the trees are dry, and as long before a rain as possible.

The purpose of applying the Bordeaux-arsenical mixture is to destroy various pests which the lime-sulphur wash failed to reach, and because it has been found more effective when applied at the times mentioned above than any other mixture in the eradication of many destructive insects and worms.

Success or failure in spraying is largely determined by the care with which the mixture is made and the thoroughness with which it is applied. The proper time is also a prominent factor in securing good results. It is the one job on the farm that will not wait, and if not done

at the right time, it is largely a waste of time to do it at all.

THE RESULTS

The benefits resulting from spraying are seen in sound, healthy trees, sound, clean fruit, and increased production. Usually it results in plenty of good sound fruit where without it there is none, or at least very little, and that little scabby, wormy, and worthless.

CHAPTER XXXIII

SOME PRACTICAL SUGGESTIONS

WHILE the writer has no wish to encroach upon the domain of the veterinarian, it seems proper in this connection to explain what should be done by the practical farmer in case disease attacks any of his animals when there is no competent veterinarian at hand.

MILK FEVER

The disease known as milk fever is not a fever at all; indeed, the temperature of the animal attacked by it is usually below normal. The best authorities now agree that it is a form of paralysis resulting from the too sudden and complete withdrawal of milk from the cow's udder.

The disease usually attacks the best cows and deepest milkers, those in which not only the udder but also the glands, ducts, and veins have become distended and remain so for days and perhaps weeks before the calf is born. Left alone, the calf will relieve the trouble as fast as nature intended, but when a whole pailful of milk is withdrawn at once, the cow's system undergoes collapse, and paralysis follows.

Symptoms. — The disease may be detected by symptoms of a chill, twitching of the muscles about the head and under jaw, failure to eat, chew the cud, or pass manure. The udder will be distended, but without milk. The hind quarters will have little feeling, the animal

becomes unsteady on her legs, and finally drops. Her neck assumes a peculiar arch, and her head is thrown around to one side and held there. She soon becomes insensible, and death finally results.

Treatment. — The first thing to do is to place the udder and milk glands back in their normal condition. If the same warm milk that had been withdrawn could be pumped back into the udder, it would have that result. Warm water would accomplish the same purpose, and air will also do it, and is the better and quicker method. At this stage every moment is valuable. Every dairyman should be provided with the air pump and complete apparatus for giving this treatment. The apparatus is provided with means for filtering and sterilizing the air before it is forced into the udder. The milk tube, udder, and hands of the operator should be washed and sterilized in some antiseptic solution, such as a 2 per cent solution of carbolic acid.

If no milk fever apparatus is obtainable, fit a milk tube on a bicycle pump and get the air into the udder without delay. Insert the tube into the end of the teat and hold the end firmly until the quarter in hand is hard and distended; then tie the end of the teat with a soft tape to prevent the air from escaping. Treat all the teats in the same manner, and if recovery is not apparent within an hour, pump in more air. The chances are about nine out of ten that the cow will get up and eat within an hour.

LICE DIPS

One of the troubles the farmer has to contend with at some period of the year is lice, which infest his calves,

young stock, or cows, and every farmer knows how difficult it is to completely eradicate the vermin with the common, prepared remedies. A remedy that is certain in its results, simple, inexpensive, and home-made is as follows: Slice one half pound of ordinary laundry soap into a kettle containing a gallon of rain water. Boil until the soap is thoroughly dissolved. Remove from the stove, and add two gallons of kerosene oil and stir vigorously for half an hour; then heat and add eight gallons of rain water, and stir the whole until thoroughly mixed.

Apply this to every part of the animal's body with a sponge, or spray pump, keeping the mass well agitated while making the application; otherwise more or less clear oil will rise to the top and in this undiluted state will blister the skin and take off the hair. One or two applications will clean the stock of all vermin.

This dip is equally satisfactory for all farm animals, including hogs. It also makes a good spray to protect stock from flies.

BOVINE TUBERCULOSIS FROM THE FARMER'S STANDPOINT

Purposely avoiding discussion of the question whether bovine tuberculosis is transmissible to human beings and therefore dangerous to human life, the subject will be considered here purely as a question affecting the health and profit of the dairy.

It must be admitted at the outset that perfect health is a prime requisite in the successful dairy, and any disease which impairs the health and lowers the vitality of the animals should be promptly eliminated from the herd. There is no question that many dairy herds contain ani-

mals suffering from this disease, some of them in the incipient form and others in more advanced stages.

The advanced stages of the disease are outwardly manifested by a rough, upstanding coat, loss of flesh, lack of appetite, and frequently a cough, with serious decrease in milk production. Such animals are unprofitable in the dairy, besides being a direct menace to the rest of the herd. The continued presence of such animals mingling with healthy ones is reasonably certain to spread the disease to all the others, and the dairyman is shortsighted indeed who allows them to remain in his dairy.

The disease in its incipient form cannot be detected from outward appearances; the animal may appear quite healthy — may indeed be the fattest animal in the herd and yield a full quantity of milk, but she should still be disposed of if the farmer's best interests are consulted. Such animals are quite likely to infect the healthy ones, and are certain sooner or later to arrive at the stage of the disease where the health will be materially affected and the malady become generalized.

What, then, should be done? There is only one sensible course to pursue: eliminate the disease, root and branch, whether in the old or young, whether in the incipient or advanced stage, and whether local or generalized.

APPLY THE TUBERCULIN TEST

It is only by applying the tuberculin test to every animal that the dairyman can be certain which ones are free from the disease. There have been many unjust things said about tuberculin, because of which many cattlemen fear that it is a dangerous agent to use, while

others fear its possible power to stimulate the latent nodules and cause active development of the disease.

The experience of several years has convinced the writer that there is no possible danger from its use, provided pure tuberculin, clean instruments, and proper care are used. The process by which tuberculin is produced renders it impossible for any active "cultures" to exist in the fluid, and there is no evidence that its application has ever developed any latent tubercle into activity.

HOW TO APPLY THE TEST

While it is always advisable to employ an experienced veterinarian in work of this character, still it is quite possible for one or more farmers in any given locality to study the subject sufficiently to enable them to not only test their own dairies, but those of their neighbors, and thereby avoid the expense incident to such tests.

A few simple rules are here laid down which it is believed will not only aid the dairyman who decides to make his own tests, but also enable him to judge if the work is properly done in case he employs a veterinarian:—

1. The test should be made under the usual conditions of feeding, watering, and surroundings.

2. Tie a tag to the tail of each animal, beginning at one end of the stable with number 1, and follow with numbers 2, 3, 4, etc., in regular order until all that are to be tested are thus numbered and tagged. Then place upon a large sheet of paper numbers corresponding to those on the tags, in a column at the left. At the top of the sheet designate the hours at which temperatures are to be taken, thus: 2 P.M., 5 P.M., 8 P.M., 6 A.M., 8 A.M., 10 A.M., etc.

3. Take the temperature of each animal at least three times before injection of tuberculin, at 2 P.M., 5 P.M., and 8 P.M., and record it opposite her number and under the time at the top of the sheet. The purpose of taking these temperatures is to secure a reliable average normal temperature from each animal.

4. As soon after 8 o'clock as the last temperatures are recorded, inject a dose of tuberculin just under the skin of each animal in the region of the shoulder, using a sterilized hypodermic syringe, after disinfecting the skin where the puncture is to be made with a 5 per cent solution of carbolic acid.

5. The dose always appears upon the label of the bottle. For adult cows it is 2 c.c.; for yearlings and two-year-olds, from 1 to $1\frac{1}{2}$ c.c.; while for bulls and very large animals it would be 3 c.c.

6. On the following morning, at 6 A.M., begin taking temperatures, and continue to take them every two hours until the twentieth hour after the injection.

7. A rise of 2° F. or more above the maximum normal temperature of the previous day (providing the temperature after injection exceeds 103.8° F.) indicates that the animal has tuberculosis. This rise in temperature is called the reaction, and appears in a more or less gradual rise until the highest point is attained, when it gradually falls until the normal is again reached. If there is a reaction, but of less extent than that above indicated, the animal should be looked upon with suspicion and subjected to a re-test six weeks later, and using a double dose.

A perfectly healthy animal that is free from all taint of the disease will not react upon the use of tuberculin.

8. The test may be unreliable if the animal is in an advanced state of pregnancy, in heat, has inflammation of the lungs, intestines, uterus, or udder, or if suffering from the effects of abortion, retention of afterbirth, or indigestion. The temperature will also rise unduly if the stable is allowed to become hot, or if the animals become unduly excited.

Under these foregoing rules there is no doubt of the correctness of this method of diagnosing tuberculosis, and out of 24,784 cattle tested and slaughtered by the federal and State officers from 1893 to 1908, 24,387 were found with tuberculosis lesions — a percentage of 98.39 of all animals condemned.

Not much progress will be made towards stamping out this disease until the dairymen come to see that it is for their interest to do so. Little progress can be made by merely enacting laws on the subject; neither can city boards of health expect to accomplish much practical good as long as they attempt to force the issue and thus antagonize the farmer. Improvement must come, as every other important improvement in agriculture has come, through the farmer himself.

CALF SCOURS

A serious difficulty, and one often encountered in raising calves, is scours. This trouble is usually the result of carelessness on the part of the feeder, and may be caused by overfeeding, feeding sour milk, cold milk, or too much cold water. It may also be caused by using dirty pails, feeding the grain in the milk, or by feeding at irregular intervals.

If signs of the trouble are seen, the milk ration should

be reduced one half and gradually increased if the trouble does not again show itself. In mild cases a reduction of the milk and the addition of a teaspoonful of dried blood will usually end the trouble; but if the case is chronic, more heroic treatment must be given. Administer a dose of castor oil consisting of about two ounces in the morning, followed in the evening with a teaspoonful of dried blood, to which has been added 20 drops of laudanum and one or two raw eggs. This treatment will usually cure the most obstinate cases, but if the trouble continues, repeat the treatment in 48 hours.

A simple and generally effective remedy in mild cases of scours is to place in the calve's mouth a tablespoonful of powdered sulphur, and hold his mouth shut for a few moments until the sulphur has become moist. He will swallow it, and may then be fed his milk.

HOW TO ERADICATE WEEDS FROM GRAIN FIELDS

It is quite possible to prevent weed development in cultivated crops, but the problem of how to eradicate weeds from fields of grain is a more serious one. Hand pulling is, at best, a back-aching job, and if the weeds are numerous and the field extensive, it is quite out of the question. A quick and simple remedy is to prepare a spray composed of 52 gallons of water and 100 pounds of iron sulphate, which is sufficient to spray an acre of weeds. The sulphate should be vigorously stirred while dissolving, and can be applied with any good spraying rig.

This mixture is not poisonous and will not injure the grain or new seeding, but it will destroy wild mustard, daisies, cocklebur, bindweed, ragweed, chicory, sheep

sorrel, yellow dock, wild lettuce, and many other weeds. The field should be sprayed when the mustard is in the third leaf and before the plant is in blossom, and should be applied in the heat of the day and in dry weather. Iron sulphate can be bought for about \$10 per ton.

HOW TO DESTROY RATS

It frequently happens that certain buildings on the farm are infested with rats and mice where it is not practicable to exterminate them with the aid of cats, dogs, or traps. Their runways may be inaccessible, or they may infest the chicken house, where, of course, cats, dogs, or traps cannot be used. Under such conditions the following method is recommended: —

Dissolve one half ounce of strychnia sulphate in a pint of boiling water, add a pint of thick sugar sirup, and stir thoroughly. Then add oatmeal and water in sufficient quantities to make a thick paste. Place a quantity of this paste upon a plate or small dish, and put over it a box with holes in each side large enough to admit the rats, but not the chickens.

If rats are to be poisoned in the dwelling house, this method may be found objectionable, because the vermin may escape under the floors and into the partitions and there die, causing offensive odors. In that case barytes should be used instead of strychnine, as its action is not so deadly, and the rats will leave the building, if possible, in search of water. A dough consisting of one eighth of its bulk of barytes, the remainder being made up of oatmeal and water, is a good rat poison.

HOW TO PREVENT HORNS FROM GROWING ON CALVES

Many farmers and breeders prefer hornless cattle, especially for the dairy, but hesitate when the subject of dehorning is broached, because they look upon the operation as cruel, and also because the practice usually leaves the horns in a more or less mutilated condition and is frequently attended with a serious loss of blood.

All of these objectionable features may be avoided if the farmer or stock raiser chooses to treat his calves when four or five days old as follows: —

Secure a stick of caustic soda, clip the hair off about the horn buttons or little points that can be felt on the calf's head, wash with clean soap and warm water, and wipe dry. Moisten one end of the stick and rub the horn buttons, first one and then the other, until each has had three applications, being careful not to touch any other part of the skin of the animal. The stick should be wrapped in paper to prevent its coming in contact with the hand. This simple treatment will prevent the growth of horns and leave the head perfectly smooth.

IF YOU DON'T KNOW

The field of agriculture is a broader field, requiring more knowledge, deeper study, and wider experience than any other subject within the realm of human investigation, and withal (except within recent years) has received the least attention from investigators.

While the practice of agriculture antedates our historical knowledge, still it is only within very recent times that most of the scientific facts regarding the subject have

been discovered, and while earnest work and investigation is now being done in every part of the country, there is still much to learn, and many problems are yet unsolved.

It is not surprising, therefore, that the ordinary farmer finds himself face to face with problems in agriculture which are beyond his efforts at solution and is frequently confronted by questions the answers to which he does not know. For the purpose of meeting just such situations and supplying helpful information regarding such questions, the several States have established departments of agriculture, colleges, schools, and experiment stations where all the information which the farmer desires may be readily obtained, and usually without charge. The federal government also maintains the department of agriculture for the purpose of investigation, experiment, and discovery in almost every line of agriculture, and every known fact is furnished to the farmer for the asking. Indeed, the whole scheme, whether State or national, is developed and maintained for the purpose of aiding the farmer, breeder, and others engaged in any department of agriculture. It would therefore seem the height of folly not to embrace the opportunity thus offered. If the subject is one upon which a bulletin has been issued, the printed sheets will be sent to any inquirer. In any case, an inquiry sent to your State experimental station or agricultural college or school will receive respectful, prompt, and careful consideration. Take full advantage of the knowledge which other men can supply; make free use of the agricultural institutions wherever you may be located; that is what they are for. Don't go it "blind" when you don't know, but ask for information.

A FEW DON'TS

Don't send a dog after the cows. He has no judgment, and is the most expensive help on the farm.

Don't milk at irregular hours. It is the surest possible way to dry off a cow.

Don't work your horses with check rein or blinds. They are uncomfortable and unnecessary, and the horse will work better and keep fatter without them.

Don't allow your animals to stand out in the rain and cold wind. It is too expensive. It requires food to supply warmth, and a good stable is the best substitute for grain.

Don't drive on your land when it is soft and wet. It will form clods which it will take time and labor to reduce.

Don't burn the weeds, but plow them under before they ripen. The land requires all the vegetable matter which you can give it.

Don't plow through a spring hole or swale. No crop will ever grow in such places until they are drained.

Don't starve the stock because feed is scarce. Better sell some of the animals and feed the rest better.

Don't dope the farm animals with patent medicines or quack remedies unless you know the nature of the ailment and the action of the medicine; and then don't.

Don't deny the horses all the fresh grass they will eat. It is the best medicine they can be given.

Don't neglect to furnish poultry with shelter and roosts. The carriage seat is too expensive.

Don't fail to read agricultural papers and farm bulletins. No man knows it all, and least of all he who does not read.

Don't quarrel with neighbors. It might lead to law-

suits, and lawsuits are luxuries which no farmer can afford.

Don't listen to lightning-rod men, patent-right sellers, or patent-medicine fakirs. They all belong to the same class, and are the only animals on the farm which the dogs should be sent after.

Don't store the farming tools and machinery in the field. One half the manufacturers of those implements would go out of business if all farmers would take care of their tools.

Don't build the pig pen near the house. It may be sociable, but it is not sanitary.

Don't work fourteen hours a day. It is not necessary, and the man who delves in the ground constantly, like a mole, might better have been a mole in the first place.

Don't neglect the cultivation of the children. They are the best crop raised on the farm, and deserve careful attention.

Don't ill use any farm animal. Kindness is always profitable, and only a coward will take advantage of his superior position to abuse dumb animals.

INDEX

A

- Acid, cause of, in soil, 47.
- A few "don'ts," 289-290.
- A good mulch maker, 102.
- Air in the soil, 2.
- Alfalfa, adaptability of, 67-68.
 - barnyard manure for, 68-69.
 - clean soil for, 70-71.
 - commercial fertilizer for, 69.
 - conditions necessary for, 68.
 - description of, 67.
 - feeding value of, 75.
 - gathering crop of, 75.
 - inoculation for, 73-74.
 - lessons from its culture, 77.
 - limed and unlimed, 51.
 - lime essential for, 70.
 - origin of, 66.
 - plate of, 67.
 - preparation for, 71.
 - preparing seed for, 71.
 - quantity of seed per acre, 72-73.
 - root system (plate), 68-69.
 - root system of, 63-64.
 - roots in drained soil, 22.
 - seed for, 71-72, 121-122.
 - time to cut, 74.
 - time to sow, 72.
 - value of, on soil, 66.
 - vegetable nutrients in, 76.
- Alsike clover, uses of, 82.
 - characteristics of, 82.
- Analysis of commercial fertilizers, 32.
- Animal feeding standards, 55-59.
- Animal food, carbohydrates in, 154.
 - constituents of, 160-162.
 - composition of, 153-154.

- Animal body, composition of, 152.
- Animal life in soil, 13.
- Arab horse, the, 213-214.
- Artificial drainage, 20.
- Ayrshire cattle, 199-201.

B

- Balanced rations, 163-165.
- Barb horse, the, 215-216.
- Barley, characteristics of, 105.
 - diseases of, 106-107.
 - rotation with other crops, 106.
 - seed for, 106.
 - soil for, 106.
 - treatment of seed for, 107.
 - uses of, 107.
 - varieties of, 105.
- Barnyard manure, and its value, 15-16.
 - for alfalfa, 68-69.
 - for corn, 96.
 - when to apply, 16.
- Beans, 90-93.
 - climate for, 91.
 - diseases of, 93.
 - harvesting of, 92.
 - seed and seeding, 91.
 - time to plant, 91.
 - uses of, 93.
 - varieties of, 90.
- Beets, ration with, 165.
- Belgian draft horse, the, 223-224.
- "Big Four," the, 58.
- Bovine tuberculosis, 280-281.
- Brown grass roots, 62-63.
- Brown Swiss cattle, 202, 203.
- Buckwheat, "the farmer's friend," 115.

- Buckwheat, uses of, 116.
- varieties of, 115.
- when to sow, 115-116.
- Bulls, choice of, 171-172.
- treatment of, 173.
- Butter, to compute yield of, 182-183.

C

- Cabbage, climate and soil for, 144.
- cultivation of, 145-146.
- preparation of soil for, 144.
- resetting of plants, 145.
- seed for, 144-145.
- value of, to farmers, 143.
- Calf scours, 284-285.
- Calves, how to feed, 191-193.
- to prevent horns growing on, 287.
- Carbohydrates in food, 154.
- Carrots, feeding value of, 140.
- soil for, 139.
- Cattle, other, 209-210.
- various breeds of, 194.
- Cereals, the, 105.
- Chapter I, 1-4.
- II, preparing the soil, 5.
- III, tilling the soil, 10.
- IV, fertilizing the soil, 14.
- V, drainage, 20.
- VI, commercial fertilizers, 30.
- VII, application of fertilizers, 35.
- VIII, lime, 46.
- IX, how plants grow, 55.
- X, root systems of field crops, 59.
- XI, legumes, 65.
- XII, clovers, 78.
- XIII, other legumes, 86.
- XIV, corn and how to grow it, 96.
- XV, the cereals, 105.
- XVI, the grasses, 120.
- XVII, root crops, 124.
- XVIII, root crops for feeding, 133.
- XIX, crop rotation, 147.
- XX, Part II, feeding farm animals, 150.
- XXI, the dairy herd, 170.

- XXII, testing milk and cream, 176.
- XXIII, feeding for milk and butter records, 185.
- XXIV, how to feed calves, 191.
- XXV, various breeds of cattle, 194.
- XXVI, origin and development of the horse, 211.
- XXVII, different breeds of horses, 213.
- XXVIII, general discussion of the horse, 230.
- XXIX, management and feeding of sheep, 235.
- XXX, pig management and feeding, 243.
- XXXI, poultry on the farm, 257.
- XXXII, Part III, the farm orchard, 261.
- XXXIII, some practical suggestions, 278.
- Choice of bulls, 171.
- Clay soils, 4.
- Clods, importance of pulverizing, 10.
- Clover root system, 64.
- Clovers, 78.
- Clydesdale horse, 227-228.
- Coach horse, 220-221.
- Commercial fertilizers, 17, 30-34.
- analysis of, 32.
- contrasted value of, 32-33.
- danger in purchasing, 31.
- how to prepare, 34.
- laws regarding, 31-32.
- objections to, 17.
- prime requisites of, 34.
- to determine price of, 33.
- Composition of the soil, 1.
- of animal body, 152.
- of animal food, 153-154.
- Compounded ration with beets, 165.
- with silo, 163.
- without silo, 164.
- Compounding rations, 154-155.
- Conserving soil moisture, 11.
- Corn, and how to grow it, 96.

- Corn, check-rowing for, 99.
 commercial fertilizer for, 100-101.
 cultivation of, 101-102.
 cultivators for, 102.
 depth to plant, 99.
 how to plant, 99.
 machinery in planting, 100.
 preparation of soil for, 96.
 root system of, 61.
 seed for, 97-98.
 soil washing on, 103.
 testing the seed, 98-99.
 time for planting, 96-97.
 yield of, 103-104.
- Crop rotation, 147-149.
- Crop yield increased by drainage, 21.
- Crops, requiring nitrogen, 39.
 root systems of, 59-60.
- Culling a dairy herd, 173-174.
- Cultivation of corn, 102-103.
- Cultivator for potatoes (plate), 129.

D

- Dairy herd, culling of, 173-174.
 formation of, 171.
 stabling of, 174.
 the, 170.
 watering of, 175.
- Dairy record sheet, 178-179.
- Danger of too much lime, 49-50.
- Depth to plow, 8.
- Devon cattle, 204-205.
- Digestible ingredients of food, 160-162.
- Ditching machines, 26-27.
- "Don'ts," a few, 289-290.
- Drainage, artificial, 20.
 as applied to agriculture, 20-21.
 benefits from, 21-23.
 benefits to root systems, 22.
 cost of, 29.
 depth of tile for, 26.
 details of systems, 23-25.
 digging ditch for, 26.
 distance of laterals, 27-28.

- filling the ditch for, 27.
 irregular system of, 23-24.
 laying tile for, 27.
 natural, 20.
 number of feet of tile per acre, 28.
 systems of, 23-24.
- Dutch belted cattle, 201-202.

E

- Extent of root systems, 62.
- Ewes, care and breeding of, 238.

F

- Farm animals, feeding of, 150-152.
- Farm orchard, the, 261.
 cultivation of, 269-270.
 grafting in, 272-273.
 improving the old, 271-272.
 intertillage in, 268-269.
 location of, 262.
 pruning in, 270.
 securing trees for, 266.
 size of trees for, 267.
 spraying the, 273-274.
 spraying formulas for, 272-273.
 tree planting in, 267.
 varieties of fruit for, 262-265.
- Feeding calves, 191-193.
 farm animals, 150.
 for dairy records, 185.
 hogs, 251.
 lambs for breeding and market, 240-241.
 mangers and racks, 168-169.
 rations for sheep, 238-239.
- Feeding standards, 155-179.
- Feeding value of alfalfa, 75.
- Fertilizers, application of, 35.
 for potatoes, 126.
 required by various crops, 36.
 saving on the farm, 18-19.
 sources of, 18.
 table of value for various crops, 36.
 which ones to use, 43-45.

Fertilizing, by plowing under crops,
17.
materials, 78.
the soil, 14-19.
Floor plan for hog house (plate),
245.
Fleece of sheep, the, 237.
Forms of lime, 53-54.

G

Galloway and Angus-Aberdeen cat-
tle, 209.
General discussion of the horse,
230-233.
Good conditions of the soil, 3.
Grain fields, weeds in, 285-286.
Grasses, the, 120.
necessity of, in pasture, 122-123.
why use in meadows, 122.
Green manures, 16-17.
for alfalfa, 69.
Growth of corn roots, 62.
of plant roots, 56.
Guernsey cattle, 196-197.

H

Half sugar mangels, 139.
Harrowing, the time for, 2.
when to do, 2.
Harvesting of mangels, 138.
Heavy draft horses, 223-229.
Hereford cattle, 205-206.
Hog houses, 244.
how to build, 244.
false floor in (plate), 246.
floor plan of (plate), 245.
front of, closed and open, 248-
249.
perspective view of (plate), 255.
portable (plate), 247.
troughs for, 250.
windows in (plate), 246.
Hogs, farrowing time, 253.
feeding, 252.
points of good sow, 251.

selection of boar, 251.
selection of stock, 250.
vermin on, 256.
Holstein-Friesian cattle, 194-196.
Horse, facts about breeding the,
232.
feeding the, 166-169.
general discussion, 230-233.
origin of, 211.
Horses, different breeds of, 213.
How plants grow, 55.
How to apply lime, 52.
How to plant potatoes, 128.
Humus, its properties and action, 2.
Hybrid turnips, 141.

I

If you don't know, 287-288.
Importance of air and water in soil,
5-6.
Improvement of pastures, 123.
Inoculation, methods of, 73-74.
Introduction, v, vi.

J

Jersey cattle, 197-199.

L

Lack of plant food in soil, 34.
Lambs, feeding of, 239-240.
twins, 241.
Legumes, characteristics of, 65-66.
value of, on soil, 66.
Leguminous crops for manure, 17.
Lice dips, 279-280.
Lime a necessary constituent of
soil, 46.
action of, on soil, 48.
as applied to land, 46.
danger of too much, 49-50.
deficiency of, 46-47.
essential for alfalfa, 70.
frequency of application of, 52.
forms of, 53.

Lime, how much to use of, 52.
 how to apply, 52.
 twofold effects of, 48-49.

M

Machines for corn planting, 100.
 Mammoth clover, characteristics
 of, 81.
 seeding for, 82.
 soil for, 81.
 Management and feeding of sheep,
 235.
 Mangels, cultivation of, 137.
 harvesting of, 138.
 seed for, 137.
 soil for, 136.
 thinning of, 137.
 Mangers, objections to, 168.
 Melons, limed and unlimed (plate),
 52.
 Milk and cream, testing of, 176-
 181.
 Milk fever, treatment of, 278-
 279.
 Milk test, how to make, 180-
 181.
 reading of, 181.
 Millet, adaptation of, 118.
 uses of, in combination, 118-119.
 pearl, 117-118.
 value of, 119.
 varieties of, 117.
 Mineral elements in the soil, 2-3.
 Morgan horse, the, 221-222.
 Muck soils, 4.
 Mulching soil, 12-13.

N

Natural drainage, 20.
 Nitrates as a fertilizer, 15.
 where found, 39.
 Nitrogen and its forms, 14-15.
 as ammonia, 39.
 from the air by legumes, 65.
 where found, 38.

O

Oats, adaptability of, 108-109.
 as a nurse crop, 111.
 as a soiling crop, 111.
 as food, 112.
 preparing soil for, 110.
 quantity of seed, 111.
 testing seed for, 109.
 treatment of crop, 110-111.
 seed for, 108-109.
 varieties of, 108.
 where grown, 107-108.
 Objections to clods after plowing,
 10.
 Orchard, the, 256.
 how to plant, 267.
 intertillage in, 268-269.
 low and high tree in, 271.
 pruning trees, 270.
 spraying in, 173-274.
 varieties for, 262-265.
 Organic nitrogen, 38.
 Organic phosphates, 41.
 Origin, and development of the
 horse, 211-212.
 of alfalfa, 66.
 Osmosis, process of, 57.
 Other legumes, 86.

P

Part II, 150.
 Part III, Chap. XXXII, 'the 'farm
 orchard, 261-277.
 Pasturage for sheep, 239.
 Pastures, improvement of, 123.
 Peas, benefit of, to soil, 89-90.
 best soil for, 89.
 their uses, 88.
 varieties of, 88.
 Percheron horse, the, 224-226.
 Periodic growth of corn roots, 62.
 Phosphoric acid, use of, 41.
 where derived, 40.
 Pigs, management and feeding of,
 243-244.

Pigs, raised partition in pen (plate), 254.
 the young, 253-254.
 Plant cells, 57-58.
 Plant foods, required in soil, 37.
 Plant roots, requisites for, 64.
 Plants benefited by lime, 50-51.
 how grown, 55.
 injured by lime, 51-52.
 the roots of, 55-56.
 Plowing, proper time for, 7.
 proper depth, 8.
 properly done, 6.
 subsoiling, 7.
 value of dead furrows, 8.
 Potash, crops improved by, 42-43.
 muriate of, 42.
 uses of, 42-43.
 where found, 42.
 Potatoes, cultivation of, 128-129.
 extent of cultivation of, 124.
 fertilizers for, 126.
 how to cut, 127.
 how to plant, 128.
 preparation of seed, 127.
 preparing seed bed for, 124-126.
 root system of (plate), 62-64.
 seed, selection for, 127.
 soil for, 124.
 spraying of, 129-130.
 Portable hog house, 247.
 Poultry, kinds to keep, 259.
 on the farm, 257.
 pure breeds of, 259-260.
 Practical suggestions, 278.
 Preparation of seed potatoes, 127-128.
 Preparing the soil, 5-9.
 Profitable breeds of sheep, 235.
 Proper plowing, 6.
 Pure bred sheep, 236.

R

Ration compounded, 163.
 Rats, how to destroy, 286.
 Record sheet for dairy, 178-179.

Red clover as hay, 80.
 as a soiling crop, 80.
 as pasture, 84.
 characteristics of, 78.
 seeding for, 79-80.
 soil for, 79.
 Red-polled cattle, 203-204.
 Red top, methods of cultivation of, 121.
 Right way to feed calves, 192.
 Root crops, average yield of, 135.
 for stock feeding, 133.
 growth of potatoes, 62.
 rotation of, 138.
 Root system, of alfalfa, 63-46.
 of clover, 64.
 of corn, 61-62.
 of corn plant (plate), 60.
 of field crops, 59-60.
 Roots, effects of soil water on, 56.
 experimental work on, 60.
 of plants, 55-56.
 Rutubagas, 140.
 Rye, characteristics of, 114.
 seeding and cultivation of, 114.
 special uses of, 114.

S

Saddle horse, the, 19-20.
 Sandy or clay loam, 3-4.
 Saving farm fertilizers, 18.
 Seed for alfalfa, 121-122.
 for barley, 106.
 for corn, 97-98.
 Seeding for red clover, 79-80.
 Separating cow and calf, 188-189.
 Sheep, care and breeding of, 238.
 feed rations for, 238-239.
 management and feeding of, 235.
 pasturage for, 239.
 profitable breeds of, 235.
 pure bred, 236.
 scab and ticks on, 243.
 the fleece of, 237.
 the yolk of, 238.
 what constitutes a good, 236.

Shire horse, the, 228-229.
 Short horn cattle, 206-207.
 Soil, acidity, 17.
 acidity increased in, 399.
 action of lime on, 48.
 animal life in, 13.
 cause of acidity in, 47.
 composition of, 1.
 essential plant food in, 37.
 exhaustion, causes of, 35.
 fertilization of, 14-19.
 lack of plant food in, 34.
 moisture, capillary attraction in,
 11.
 moisture, conservation of, 11.
 mulch in, 12-13.
 preparation of, 5-9.
 required for, 70-71.
 testing methods for, 47-48.
 the, 1-7.
 varieties of, 3.
 Soiling with red clover, 80.
 Soils affected by plowing, 7.
 deficient in lime, 46-47.
 differences in, 37.
 returning essentials to, 37.
 Soil water, 2.
 effects of, on roots, 57.
 Soluble phosphates, 41.
 Sow, good points of, 251.
 Soy beans, 87.
 Spray, formulas for, 274-277.
 Spray mixture, tests of, 131.
 uses of, 131-132.
 Spraying, the orchard, 273-274.
 potatoes, 129-130.
 Spring balance (plate), 178.
 Stables, ventilation of, 174-175.
 Stabling a dairy herd, 174
 Stock foods, relative value of,
 135.
 Subsoil, 1.
 Subsoiling, its value, 9.
 Sugar beets, 138.
 Sulky plow, the, 8.
 Sussex cattle, 208.

T

Testing, cows, how done, 187-188.
 milk and cream, 176-181.
 seed corn, 98-99.
 the grasses, 120.
 the soil, 47-48.
 The soil, 1-4
 Thoroughbred horse, the, 216-217.
 Tile, depth to lay, 26.
 different kinds of, 28.
 laying for drains, 27.
 number of feet per acre, 28.
 Tilling the soil, 10.
 Time, for harrowing, 11.
 to cut alfalfa, 74.
 to plow, 7.
 to sow alfalfa, 72.
 Timothy, limed and unlimed (plate),
 49.
 methods of cultivation of, 120.
 quantity of seed for, 121.
 Treatment of bulls, 173.
 Trotting and pacing horse, the,
 217-219.
 Tuberculin test, the, 281-282.
 application of, 282-284.
 Tuberculosis, bovine, 280-281.
 Turnips and rutabagas, leaves of,
 140.
 cultivation of, 142.
 growing of, in corn, 142-143.
 hybrid, 140.
 preparing soil for, 142.
 seed for, 142.
 soil and climate for, 141.
 Twin lambs, 241.

U

Unfavorable soil conditions, 3.
 Unimportant legumes, 94-95 .

V

Value of root crops for stock, 133-134.
 Varieties of apples, 262-265.

Various breeds of cattle, 194.
Ventilating stables, 174-175.
Vetches, the, 94.

W

Weeds in grain fields, 285-286.
Wheat, diseases of, 113.
 enemies of, 113-114.
 roots of, 62.
 seed for, 113.
 varieties of, 112.

 when to sow, 113.
 winter, 112.
When to do harvesting, 11.
White clover, 84-85.
 characteristics of, 85.
 for pasturage, 84-85.
Wolff-Lehman feeding standard,
 157-159.

Y

Yield of butter, computing of,
 182-183.

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